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EXPLOITATION OF DELIVERY PROCESS INFORMATION TO DEVELOP BUSINESS PERFORMANCE IN PROJECT BUSINESS

Master of Science thesis

Examiner: prof. Miia Martinsuo
Examiner and topic approved by the Faculty Council of the Faculty of Business and built environment on 27th March 2017

ABSTRACT

Eero Varjola: Exploitation of delivery process information to develop business performance in project business
Tampere University of Technology
Master of Science Thesis, 84 pages, 6 Appendix pages
April 2017
Master's Degree Programme in Industrial Engineering and Management
Major: Industrial and business economics
Examiner: Professor Miia Martinsuo

Keywords: information, delivery process, project business, information systems, resource management, business performance

Business performance improvement requires that businesses have information regarding performance levels and are able to utilize this information to develop business processes and activities. The more there is business information to be gathered and analyzed, the more important becomes the role of information systems. The research problem of this thesis is associated with information management and information system utilization to improve business performance in project and resource management. The main goal of this research is to discover, what project management related information is of interest for business unit managers when evaluating the business performance. Another goal is to recognize and utilize the important human resource and vehicle tracking related data that could result in higher efficiency in resource planning and fieldwork monitoring.

The case company operates in telecom network and maintenance service business. A constructive research design is used to propose ways to communicate the information gathering and utilization needs e.g. to business unit managers and planning engineers. A combination of a workshop, meetings and an interview was used for data collection.

The results include an information model for the project type deliveries process related information gathering and utilization for business unit managers and planning engineers to monitor the important information. The findings indicate that there are several indicator categories that should be of interest. In addition, the project related indicators help to find the best practices and on the other hand those areas, which require development. The resource planning related results show that the project management information system usage and project and job planning in Gantt are essential tools to estimate the resource demands. The demand related information should be connected to the personnel availabilities and competencies information and utilized in the work order dispatching system. In addition to human resources, vehicle tracking is essential in fieldwork management and logistics optimization. Case company's tracking reports were improved visually and comparison between vehicles made easier in order to keep managers' focus on relevant issues and save time in the report analyzation. The results of this research highlight that through the utilization of information systems and gathering of essential delivery process information, an opportunity to develop processes and practices in project management and resource usage for business performance improvement is created.

TIIVISTELMÄ

Eero Varjola: Toimitusprosessiin liittyvän tiedon hyödyntäminen liiketoiminnan suorituskyvyn kehittämiseksi projektitoiminnassa
Tampereen teknillinen yliopisto
Diplomityö, 84 sivua, 6 liitesivua
Huhtikuu 2017
Tuotantotalouden diplomi-insinöörin tutkinto-ohjelma
Pääaine: Talouden ja liiketoiminnan hallinta
Tarkastaja: professori Miia Martinsuo

Avainsanat: informaatio, toimitusprosessi, projektitoiminta, tietojärjestelmät, resurssienhallinta, liiketoiminnan suorituskyky

Liiketoiminnan suorituskyvyn kehittäminen vaatii, että yrityksillä on tietoa suorituskyvyn tasosta ja että ne pystyvät hyödyntämään tätä tietoa liiketoimintaprosessien ja -aktiviteettien kehittämiseksi. Mitä enemmän on liiketoiminnasta kerättävää ja analysoitavaa informaatiota, sitä tärkeämmäksi muodostuu tietojärjestelmien merkitys. Tämän lopputyön tutkimusongelma liittyy informaation hallintaan ja tietojärjestelmien hyödyntämiseen liiketoiminnan suorituskyvyn parantamiseksi projektien ja resurssienhallinnassa. Tutkimuksen tärkein tavoite on selvittää, minkä projektienhallintaan liittyvän tiedon tulisi olla liiketoimintayksiköiden päälliköiden mielenkiinnon kohteena, kun arvioidaan liiketoiminnan suorituskykyä. Toinen keskeinen tavoite on tunnistaa ja hyödyntää ihmisten ja ajoneuvojen hallintaan liittyvä tärkeä resurssidata, joka voisi johtaa korkeampaan tehokkuuteen resurssisuunnittelussa ja kenttätyön seurannassa.

Tämän tutkimuksen kohdeyrityksenä oleva palveluyritys toimii tietoliikenneverkkojen rakentamisen ja ylläpidon liiketoimintaympäristössä. Tutkimusmenetelmänä käytetään konstruktiivista tutkimusta löytämään tavat kommunikoida tiedon keräämisen ja hyödyntämisen tarpeet esimerkiksi yksikön päälliköille ja suunnittelijoille. Konstruktion materiaali kerättiin yhdistelmänä työpajasta, palavereista ja haastattelusta.

Tulokset sisältävät tietomallin projektityyppiseen toimitusprosessiin liittyvästä tiedon keräämisestä ja hyödyntämisestä yksikön päälliköille ja suunnittelijoille tärkeän tiedon seurantaa varten. Havainnot kertovat, että yksikön päälliköiden ja suunnittelijoiden tulisi olla kiinnostuneita useasta mittarikategoriasta. Projekteihin liittyvät indikaattorit helpottavat löytämään parhaat käytännöt ja toisaalta ne osa-alueet, joissa on kehitettävää. Resurssisuunnitteluun liittyvät tulokset kertovat, että projektienhallinnan tietojärjestelmän käyttö ja projektien ja töiden suunnittelu Gantt:ssa ovat oleellisia työkaluja resurssien kysynnän tason arvioimisessa. Kysyntäinformaatio tulee yhdistää henkilöstön saatavuuteen ja kyvykkyyksiin, ja sitä tulisi hyödyntää töiden osoittamiseen tarkoitetussa järjestelmässä. Henkilöstöresurssien lisäksi, myös ajoneuvoseuranta on oleellista kenttätyön hallinnan ja logistiikan optimoinnin näkökulmasta. Kohdeyrityksen ajoneuvoseurantaraportteja kehitettiin visuaalisesti ja eri ajoneuvojen vertailua toisiinsa tehtiin helpommaksi, jotta managerit kykenevät keskittymään oleelliseen tietoon ja säästämään aikaa raporttien analysoinnissa. Tämän tutkimuksen tulokset korostavat, että tietojärjestelmiä hyödyntäen ja olennaista toimitusprosessitietoa keräämällä, luodaan mahdollisuus kehittää prosesseja ja käytäntöjä projektienhallinnassa ja resurssien käytössä koko liiketoiminnan suorituskyvyn parantamiseksi.

PREFACE

This thesis process was longer compared to the original plan, but in the end, the results show that hard work pays off. The longer schedule creates new challenges, because there is a lot of collected research material from different periods. It is important to delimit the research context right in the beginning of the research process. A well-designed process is half done.

The research environment was extremely interesting. New information system implementations always require well planned and executed change management, and it was an important learning experience for me as well. The atmosphere in the project management office and development department is very supportive, so there was no problems at all to collect information and receive feedback during the thesis process. I want to especially thank my supervisor in the case company, who has exceptional communication skills and is always ready to support. I have also learned a lot from the business development department's project manager, who has an innovative mindset and a wide area of expertise.

I want to also thank professor Miia Martinsuo for guiding this thesis and giving excellent feedback throughout the research process. This thesis would lack in many areas without those comments. I also cannot thank enough my family for everything you have done for me. Because of you and your never-ending support, I am soon graduated and ready to take on new challenges.

Tampere, 13.4.2017

Eero Varjola

CONTENTS

1. INTRODUCTION

This thesis work concentrates on information utilization in certain key business areas in business units. This information, which is of interest, is gathered especially from delivery processes, but also from sales processes for specific resource management purposes. This chapter starts with the background discussion related especially to data and information. Then the discussion continues with research related topics, which unveil research context, problems, questions, objectives and approach.

1.1 Background

Business development – majority of business goals relate to this topic. Companies define strategies and actions to continuously improve their business performance. Continuous business development is not an option; it is a necessity. In order to compete against the rivals, companies need to find ways to capture higher sales and/or improve their cost efficiency. One of the key aspects in the plans and actions creation process for business development is how well business information is gathered, managed and analyzed in the company. Efficient use and utilization of this information enables managers to make precise, fast and reliable decisions.

Just like for example people, materials and energy, also information can be seen as a central resource of a company. Information "world" can be divided into three distinctive "subworlds" (Adeoti-Adekeye 1997, p. 319): The first one is the literature world consisting of information in recorded form locating in libraries and archives. The second is the document world, which deviates from the literature world, as the information is not evaluated in the same sense. Finally, the third world is the data world, where telecommunications, computers and automated information systems are present. In this research study, the interest is in the data world, where data is handled in the information technology solutions and utilized to develop useful information for business managers.

The amount of data in the data world, also known as digital universe, is growing at an incredible pace every year. International data corporation (IDC) forecasts that the digital universe will grow from 2005 to 2020 by a factor of 300 (Gantz & Reinsel 2012, p. 1). In data units this means that the total amount is expected to grow from 130 exabytes to 40 000 exabytes, or 40 trillion gigabytes. Naturally rapidly mounting data sets higher requirements for the data universe infrastructure (such as IT software, hardware and telecommunications). According to IDC's estimates for the year 2020, up to 33% of the digital universe information might be valuable if analyzed (Gantz & Reinsel 2012, p. 2).

The means and ways of acquiring, storing, protecting and processing data is called data management. Making sure that the data is accessible, in order and up-to-date are also essential tasks in the data management. Levitin and Redman (1998) emphasize that to be able to properly manage data as a resource, companies must understand its characteristics and differences compared to different resources in the company. What mostly separates data from other resources is the intangibility, shareability and nonfungibility properties of data (Levitin & Redman 1998, pp. 91-93). The incapability of defining something with human senses is the definition of intangibility. Unlike energy, raw materials or people, it is not possible to define data with senses. Shareability of data refers to the fact that users are able to use the same unit of resource or in other words, share the data and use it either simultaneously or separately. Fungibility characteristic of resource means that a unit of resource could be substituted with another unit of that same resource type. Because the unique nature of data, replacing a piece of data with another piece is not possible, which signifies the nonfungibility.

One reason for the explosive data growth and evolvement how data is managed and gathered is the internet of things (IoT). Internet of things refers to the network between devices, vehicles, buildings and other physical objects. Gartner (2014) forecasted that in 2015 there would be 25 billion connected “things” in use. This sets high standards for the data management in companies and highlights the importance of IT systems to assist users (people) to classify and analyze data to utilize it for example in operations management, decision making and reporting.

These previously discussed topics are very much related to the overall scope of this thesis. In the case company, which this thesis is created for, there are significant IT system development projects underway. This raises the need to define, what data could and should be managed and what information should be of interest in order to improve the performance of business units, decision-making and reporting.

1.2 Research context and case company introduction

This thesis work is made for an industrial service company, which offers services in power networks, telecom networks, industry and information management sectors. The basic business goal in the company is to enable customers (e.g. telecom operators) to focus in their core business. The target company has the capability for instance to offer network maintenance and construction services for the customers, so that the customer can focus on the end customers (consumers, municipalities) and ensure their satisfaction for the operator subscription functionalities. Business operations of the case company locate in the Nordic and Baltic countries. The Baltic operations are part of the Power Network (PN) division. Other divisions are connected to telecom network (TN), industry (IN) and information management (IM) business operations. In total there are approxi-

mately 3000 professionals working for the group in a hundred locations. Thus, the company is clearly categorized as a large enterprise, because the total amount of persons employed is over 250 (Eurostat 2015).

In the power network division, the services include e.g. transmission and infrastructure networks designing, constructing and maintaining. Telecom network division on the other hand concentrates on designing, constructing and maintaining telecom networks and also does installations, fault repair and offers telematics services. Fulfilling the needs of industry and energy production section needs is a responsibility for industry division, which offers operational, maintenance and project services. In addition, information management division serves mainly energy markets by providing information system (IS) services. Baltic division handles the power network, telecom network and industry services in the Baltic countries, also including business development.

Out of previously mentioned business divisions, this thesis work will concentrate on the telecom network division (TND) in Finland and in more detail will focus on the telecom network construction and maintenance business line operations. Under the telecom network division in Finland is also the project office, development and product management team, which is closely connected to telecom network construction and maintenance business line. The author of this thesis is part of the development team during the research process. Telecom network Task and Construction business line divides into business units (BU) across Finland. The everyday operations and work control is managed in the business units. BU offers services for the local customers and these services are separated into five product/service categories: fixed network construction, mobile network construction, network device construction, installation/subscription delivery and fault repair. As mentioned, the field operations are executed in the business units, but the responsibility of each product category lies in the product management team and on the shoulders of named product category managers. TND Finland organization and dimensions are presented in ***Figure 1***.

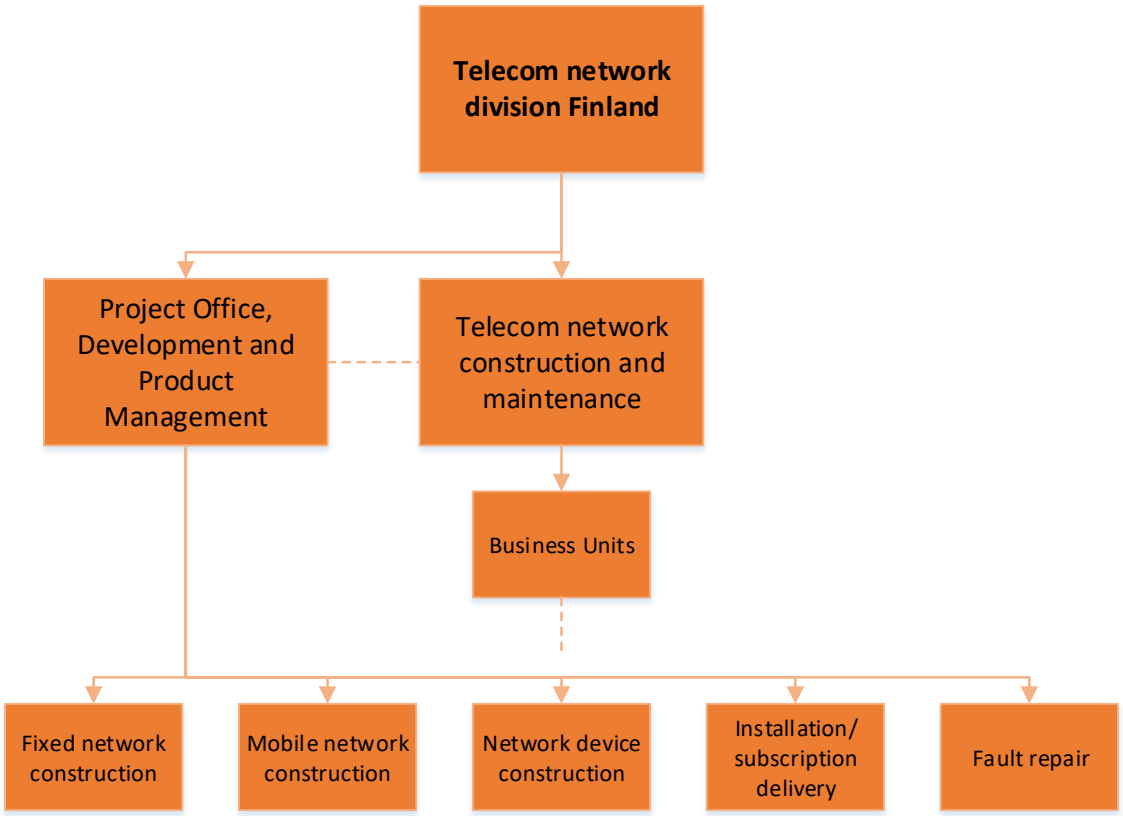

***Figure 1**. TND Finland dimension chart.*

The development team focuses on improving the processes in TN Task and Construction business lines. Most development potential occur in the Construction operations, which drives the focus of this research to this business line.

1.3 Research problem and areas of interest

Several development areas and objectives for 2017 have been determined in the case company. This "development roadmap" defines the key business areas, which need refining and new practices in order to improve the operational efficiency and reporting in the company.

From 2015 to the beginning of 2016 (the 1st quarter) there were a couple of significant information system development projects. The first major project included adding a project management system to the IT architecture. The main purpose is to manage the everyday projects and jobs more efficiently and keep track of them. This IT program effects especially to the management of telecom network construction projects. The other significant project is the acquisition of a new purchasing management system. The materials and subcontracting purchases are handled in this new system.

Partly because of these previously mentioned new IT systems, the amount of gathered and analyzed data from the service operations (delivery processes) is growing. There are

naturally also several other internal information systems where various data is gathered – such as enterprise resource planning system (ERP), fieldwork management, vehicle location and operation management system. Therefore, a great amount of data is gathered, but general opinion in the company is that the data is not properly utilized to maximize the benefits. The main questions include: what data should we gather from these internal IT systems (connected to delivery process) and how should we analyze/utilize this data to develop the operational performance and reporting.

One of the areas, where the data should be utilized more efficiently, is project/work management in business units. The greatest development potential arise in telecom network construction business, where the financial control and work implementation process monitoring is lacking. There is no clear knowledge of what phase the individual jobs are in and when are they delivered. This makes the internal monitoring of the jobs challenging and damages the customer communication. Furthermore, if there is no strong control over the individual jobs, there is no clear knowledge over occurring future income and costs either. This has an effect also outside the boundaries of business units to upper levels in the organization, because it hinders the financial reporting to business line manager and even further to organization's executive group.

Another aspect also related to the project and work management in business units is human resource management. The challenge is that if we do not have specific information of future workload and schedule, we do not have information for resource management of required capacity either. The demand for telecom network service is relatively volatile, which highlights the importance of capabilities to forecast future demands and capacity requirements accurately. TN construction business is significantly quieter during the winter time, when the weather conditions make the cable digging challenging or even impossible. The highest demand peak is naturally therefore during the summer time.

The third area of interest is vehicle management/logistics. Vehicle tracking system data analyzation is needed to make sure the field operations are implemented cost effectively and jobs/tasks are performed according to customer demands.

1.4 Research questions and objectives

Based on the areas of interest in the case company, the research questions and objectives can be determined. The managed and analyzed data (in sales and delivery processes) in the company is the key to accomplish development in central business operations, such as project/work and resource management. Because the development of these central business operations is essential to the case company, the main research question is

How can business units improve their performance in project/work management and resource management?

Under this main question can be a couple of sub-questions outlined, which are naturally closely related to the main research question. The research sub-questions are the following:

1. *What delivery process related information do BUs need in BU's project management?*
2. *What relevant information/data should BUs collect from sales and delivery processes for BU's resource management (including human resources and vehicles)?*

The perspective in these research questions is slightly ambiguous. The data collection and utilization is in the hands of business units (BUs), but it has an effect also to the reporting of business line manager. The data is collected in business units, but the utilization of that data affects not only business units, but also business line level reporting.

The objectives of this research can be divided into two categories: managerial and scientific objectives. From managerial point of view, the objective is to improve the information usage in the business units (for example with the help of new and improved business reports) and utilize that information to improve business performance. The goal is to reveal the most important project and resource related information from IT systems and create possibilities for business managers to utilize the information in business unit management and leadership. From scientific point of view, the objective is to identify the importance of information systems and information utilization in project business and present ways how business could improve its performance though the usage of ISs. It is also important to present the choices made, results and analyzation with an explicit justification in order to make the study as straight forward as possible to grasp for the reader.

1.5 Research approach

The chosen research approach for this study is constructive research approach. The purpose in constructive research is to solve practical explicit problems through creation of an innovative construction (Kasanen et al. 1993, p. 244; Lukka 2001). According to Lukka (2001), constructive research approach is a sub-method of case study. The role of the research is outsider and the research process builds on previous theories closely connected to the observed/researched field. An intervention, which is created in the research process and implemented in the case company, is a way to make a change in the company. The change is accomplished through the creation of a construction, which could be e.g. a model, diagram, plan or an organizational structure (Kasanen et al., p. 245).

Constructive research approach was chosen for this study, because there is a real-life challenge in the case company in information gathering and utilization from information systems. In addition, a construction that includes e.g. an information model would be a relevant tool to communicate to specific interest groups, what information should be gath-

ered from the project type deliveries (including ABC- and D-projects from the case company perspective) process and followed in detail. The construction that might include a model, process description and/or reports, is created in co-operation with case company managers and especially with business development experts.

Lukka (2000) has listed basic conditions that need to be fulfilled so that the research approach is classified as constructive research:

1. The research focuses on real-life problems that require solving
2. A construction is created in the research process and it has a purpose to solve the real-life problem
3. The process includes an attempt to implement the construction in order to test its feasibility
4. Close co-operation between practitioners (people in the target/case organization who participate in the research process) and researcher
5. Valid linkage between the research subject and theoretical knowledge
6. Special focus on creating a theoretical impact (reflecting empirical results back to theory).

Lukka (2001) has also defined in detail the constructive research process, which consists of seven steps to achieve the research objectives and fulfil the conditions presented in the previous paragraph. This process is shown in Figure 2.

Figure 2. *Constructive research process (adapted from Lukka 2001).*

Kasanen et al. (1993, p. 253) used a market-based validation method to evaluate managerial constructions. There are three different types of market tests: weak market test, semi-strong market test and strong market test. The weak market test asks whether the responsible manager is willing to apply the construction in practice and in decision making. The semi-strong market test goes slightly further and asks whether the construction has become widely adopted by companies. The operational or financial results are under a magnifying glass in the strong market test: it seeks to compare those business units who have applied the construction and those who have not. The purpose is to find out whether the construction is able to produce better results in practice.

Oyegoke (2011) has captured the essence of constructive research and compiled the features of this research approach into single figure, which is presented in Figure 3. According to Oyegoke (2011, p. 592), the constructive approach adds to the existing body of knowledge, is a logical approach and contains evidence to support the feasibility of the created solutions in practice.

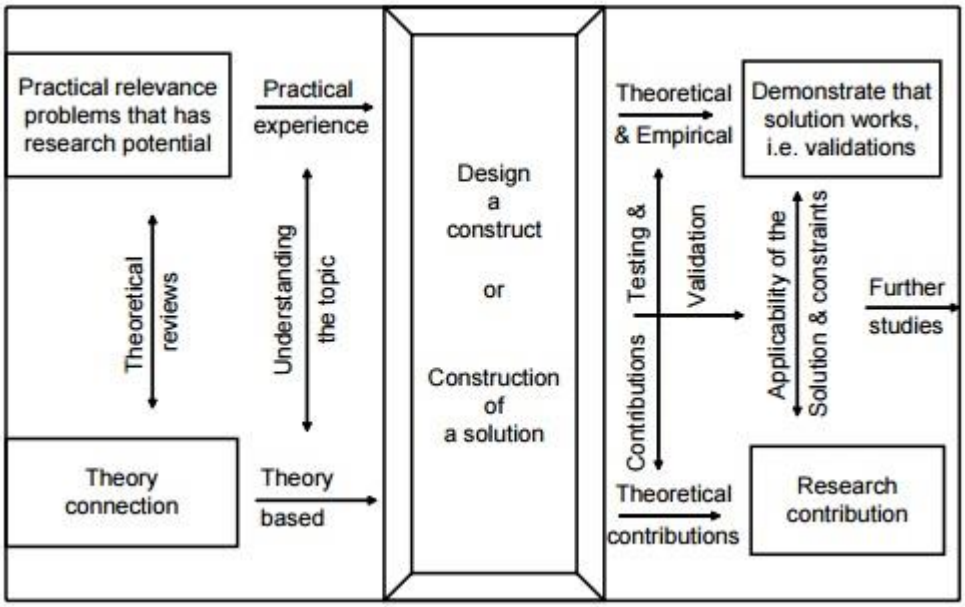

Figure 3. *Mechanisms of a constructive research approach (Oyegoke 2011, p. 580).*

Based on the presentation of the constructive research approach above, this particular research approach settles well in the thesis research context. The challenges in information gathering and utilization to improve business performance in project business (and for service providers) has a great potential also from scientific perspective. Existing empirical studies related to e.g. key performance indicators and forecasting methods in resource management are connected to the practical research. Based on the theory, a tentative construction is created. In the results and discussion sections of this research, an updated framework/construction is presented. In the conclusion, the contribution of this research to the scientific discussions is also evaluated. The research strategy and practical implementation of this research are discussed in detail later in chapter 4.

2. INFORMATION SYSTEMS AND INFORMATION USAGE IN ORGANIZATIONS

Modern businesses need systems and tools to capture data, process it into information and utilize it in operations to compete against the rivals on the market. An information system (IS) is an entity that businesses use to create useful information for processes and managers. There has been a great deal of controversy in the literature, how to define an information system. This controversy rises from the fact that many people have studied IS from a variety of perspectives, which creates also a variation of definitions (Paul 2007, p. 194). Paul (2007, pp. 193-194) has identified also four other challenges related to the state of the information systems discipline:

1. *Lack of knowledge about IS outside the IS community*
   IS is not distinct when expert opinion is sought. It does not attract public attention, other than in cases of some kind of an error. Computer Science Community is more present and more popular option when technology and system related expertise is needed.
2. *In the educational environment the demand for IS is declining*
   Students in universities prefer management courses, which is partly guided by the underlying trends. This on the other hand results in high number of such graduates and creates a need for IS and computing experts. And further, the consequences of this should raise the popularity of IS and computing in the educational environment.
3. *Published IS research content is not appropriate*
   One of the problems in the IS research is that the publications do not seem to be connected to practical problems.
4. *Journal rankings*
   Publishing in fewer and fewer journals is nowadays a reality, because the top journals are naturally the most desired ones to publish in. A publication in a top journal is the best possible promotion for the researcher, but if we are looking the scientific focus areas, the fashion is towards narrowing subjects.

Reflecting to these dilemmas presented by Paul, it becomes clear that in the research environment information system is a contradictory subject. The first step in untying this knot is to attempt to look for a proper definition for information systems.

2.1 Definition of an information system

As stated earlier, different perspectives in the research and objects where information systems are applicable for make the defining of IS challenging. Carvalho (2000, cited by

Alter 2008, p. 2) has identified four of these objects, which can be seen as information systems:

1. **Organizations** who provide information for their clients
2. **A sub-system** (for example inside an organization) that assures the communication between managerial and operational units.
3. **Processors** that deal only with information and is a **computer-based system** (machines do all the work)
4. **Processors** that deal only with information (**people** are also present alongside **machines**)

Alternative definitions of information system in the literature are presented in Table 1. These definitions depend on the previously mentioned objects – what is the role of the information system in the study, i.e. which object is being researched.

Table 1. *Information system definitions from the literature (adapted from Alter 2008, pp. 2-4).*

Buckingham et al. (1987, p. 18), cited by Avison & Myers (1995)	"A system which assembles, stores, processes and delivers information relevant to an organization (or to society) in such a way that the information is accessible and useful to those who wish to use it, including managers, staff, clients and citizens. An information system is a human activity (social) system which may or may not involve computer systems."
UKAIS, United Kingdom Academy for Information Systems (1997)	"Information systems are the means by which organizations and people, utilizing information technologies, gather, process, store, and use and disseminate information."
Davis (2000, p. 67)	"A simple definition might be that an information system is a system in the organization that delivers information and communication services needed by the organization. This can be expanded to describe the system more fully. The information system or management information system of an organization consists of the information technology infrastructure, application systems, and personnel that employ information technology to deliver information and communication services for transaction processing/ operations and administration/ management of an organization. The system utilizes computer and communications hardware and software, manual procedures, and internal and external repositories of data. The systems apply a combination of automation, human actions and user-machine interaction."
O'Brien (2003, p. G-10)	"(1) A set of people, procedures, and resources that collects, transforms, and disseminates information in an organization. (2) A system that accepts data resources as input and processes them into information products as output."

Gray (2006, p. 305)	"An automated or manual collection of people, machines, and/or methods to gather, process, transmit, and disseminate data. Information systems are used to acquire, store, manipulate, manage, display, transmit, or receive data. It includes both hardware and software."
Lyytinen & Newman (2006, p. 3)	"an organizational system that consists of technical, organizational and semiotic elements which are all re-organized and expanded during ISD (information system development) to serve an organizational purpose ."
Paul (2007, pp. 194-195)	"The IS is what emerges from the usage that is made of the IT delivery system by users (whose strengths are that they are human beings, not machines). This usage will be made up of two parts: 1. First the formal processes, which are currently usually assumed to be pre-determinable with respect to decisions about what IT to use. … 2. Second, the informal processes, which are what the human beings who use the IT and the formal processes create or invent in order to ensure that useful work is done."
Rainer et al. (2007, p. 393)	"A process that collects, processes, stores, analyzes, and disseminates information for a specific purpose; most ISs are computerized."
Jessup & Valacich (2008, p. 567)	"Assumed to mean computer-based systems, which are combinations of hardware, software, and telecommunications networks that people build and use to collect, create, and distribute useful information."
Kroenke (2008, p. 6)	"A group of components that interact to produce information. The five components of an information system are hardware, software, data, procedures, and people."

When constructing a synthesis of these ten definitions, a dominant understanding is that an information system is a sub-system/process/group of components, which collects, stores, processes, transmits and disseminates data in order to serve a specific purpose. The data is transferred into useful information so that people could make use of it. The information system most likely involves a use of computers and software (nowadays particularly), albeit there also exist opinions amongst the researchers that information systems do not necessarily involve a use of a computer system.

Alter (2008) himself defines IS as a special case of work system. A work system is a system where people (participants) and/or machines perform a business process, in which resources (such as information and technology) are used to produce a product and/or service for internal or external customer (Alter 1999, p. 8). The roles between these concepts are clarified in a work system framework, which is introduced in Figure 4.

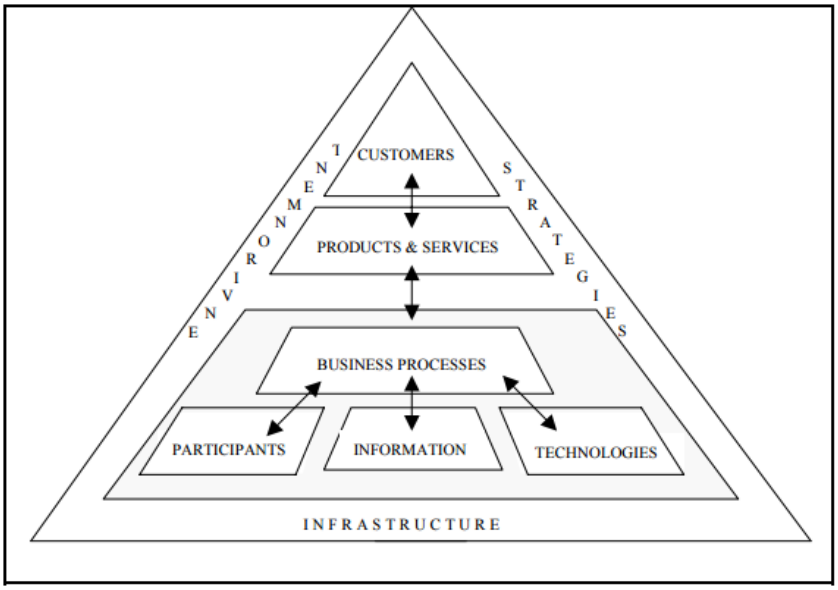

Figure 4. *The work system framework (Alter 2002, p. 93).*

The system is affected by the infrastructure (organization's resources outside the work system), organizational environment and organization's strategies. Alter's (2008, p. 6) IS definition builds on this framework and is as follows:

> *"An information system is a work system whose processes and activities are devoted to processing information, i.e. capturing, transmitting, storing, retrieving, manipulating, and displaying information.*
>
> *Thus, an information system is a system in which human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce informational products and/or services for internal or external customers."*

This definition of IS fits very well to our research environment at hand. The case company performs business processes (for example sales and delivery process), where people (participants) use technology and information. Besides the usage of information, business processes with the help of IT tools (software) create new information products for e.g. managers to use in reporting and decision making. What we are interested in are especially the new information products created in the information system. The case company has a need to form a better understanding of the information created in the business processes.

2.2 Types of information systems

According to Laudon & Laudon (2007a), information systems could be classified from two perspectives: from a functional or a constituency perspective. The functional perspective builds on the core processes of a business (Laudon & Laudon 2007a, pp. 44-51, which are

- Sales and marketing
- Manufacturing and production
- Finance and accounting
- Human resources

Sales and marketing information systems support e.g. contacting, selling and ordering processes. Manufacturing and production ISs on the other hand deal with service development, delivery and resources, when we take a service point of view instead of the more traditional tangible product manufacturing view. Financial and accounting ISs are used for financing, capitalization and financial records creation to mention a few. Company's workforce is managed in human resource ISs, which includes for example recruiting and training programs information. (Laudon & Laudon 2007a, pp. 45-51) The common factor for these systems is that certain data (e.g. sales file including item number, sales price etc.) is first harvested and moved to the system, and then it is processed in the system (possible combined with other data) in order to create an information product/output (e.g. report on maintenance service sales for customer A in January 2016) for employees or managers to use.

Nickerson (2001) classifies information systems based on the IS impact, i.e. how wide of an effect to a target group a certain information system has. This way the ISs can be categorized as individual, workgroup, organizational, interorganizational and global information systems. An example of an individual system is a spreadsheet software on individual's personal computer. For other Nickerson's defined categories there are systems such as e-mail (workgroup IS), payroll system (organizational IS), electronic data interchange (interorganizational IS) and global production scheduling system (global IS). (Nickerson 2001, pp. 12-16)

If we want to evaluate information systems and their effect on different organization levels and manager's decision making, we take a constituency perspective. Four different system entities on total of three levels can be identified from this perspective (Laudon & Laudon 2007a, pp. 52-57):

- Transaction processing system (TPS)
- Management information system (MIS)
- Decision support system (DSS)
- Executive support system (ESS)

Transaction processing systems function on the operational business level, where the primary target group for the information created is operations managers. It is actually slightly debatable, whether we should talk about information or data creation, when transaction processing systems are reviewed. According to Barron et al. (1999, p. 2), a TPS captures data, but does little to convert it to information or knowledge, and is thus called also a data processing system. Examples of processes that are handled in TPSs are orders, purchases, invoices and work control.

Management information system and decision support system are used on the middle management level. MIS provide middle managers with reports that take a stand on organization's current performance, and this information is further used to monitor and control the business and predict what future performance is like (Laudon & Laudon 2007a, p. 53). MIS utilizes the data created in TPSs (i.e. data could be collected from several TPSs) to present an informative report for managers (Barron et al. 1999, p. 2). An example of MIS report could include information of actual vs. planned sales of a certain service under a certain period of time. In other words, MIS creates (structured) reports periodically for managers so that they keep track on how the organization is performing, which includes routine decision making.

Decision support system also serves middle management, but unlike MIS, DSS supports nonroutine decision making (Laudon & Laudon 2007a, p. 54). DSS provides information to decision making situations, where problems are unique. This means that the reports created through DSS are special and serve mainly the unstructured decision making process. D.J Power has defined five different types of decision support systems: communications-driven, document-driven, data-driven, knowledge-driven and model-driven systems (Power et al. 2015, p. 1). Communication-driven DSS uses technologies related to network and communications to enhance collaboration and support decision making. Document-driven DSS utilizes storage and processing technologies in order to provide decision makers with comprehensive documents (procedures, specifications, catalogs etc.). Data-driven DSS highlights the capture and manipulation of internal (and sometimes external) data with tools such as online analytical processing (OLAP). Artificial intelligence and statistical inference technologies are used to make action recommendations for managers in knowledge-driven DSS. Last but not least, model-driven DSS makes use of e.g. simulation and optimization models (quantitative data utilization) to support the decision making process. (Power et al. 2015, pp. 1-2)

The last main category of information systems includes executive support systems (also known as executive information system or EIS). As can be deduced from the name, executive support systems are meant to be utilized on the highest management level of an organization. What is characteristic for ESS is that the information created is supposed to support longer term (strategic) decision making (Laudon & Laudon 2007a, p. 57). Senior

managers are interested to find answers to questions such as “which business opportunities and new services arise in 5 years?” or “how are our customer or competitive business environments developing?”. Shorter term decision support is by no means excluded, but executives can utilize ESS daily to for example monitor performance, spot trends, identify and solve problems, and perform “what-if” analyses (Vandenbosch 1999, p. 78).

The previously mentioned information systems are very much interrelated. Transaction systems collects the lower level operational data and shifts it forward to management information systems and decision-support systems. MIS transfers information to DSS and ESS. Also DSS can transfer its information to upper level executive support system. Unfortunately, in reality these systems are often only loosely integrated. (Laudon & Laudon 2007a, p. 58) The relationship between different types of information systems is clarified in Figure 5.

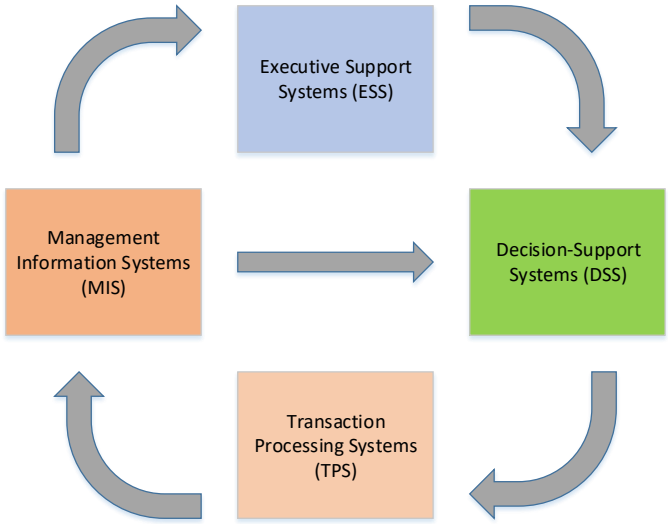

Figure 5. *The relationship between different types of information systems (Laudon & Laudon 2007a, p. 59).*

Decision making level has an effect on which information system to use. The three decision levels are operational, tactical and strategic level. Strategic managers are involved with long-term decision, where the decision frequency is low. On the other hand, operational managers are faced with every-day challenges and have to make decisions frequently. Tactical decisions are located somewhere in between these previously mentioned decision levels. We can further clarify the difference and relationship between different IS type with the decision making levels (Figure 6).

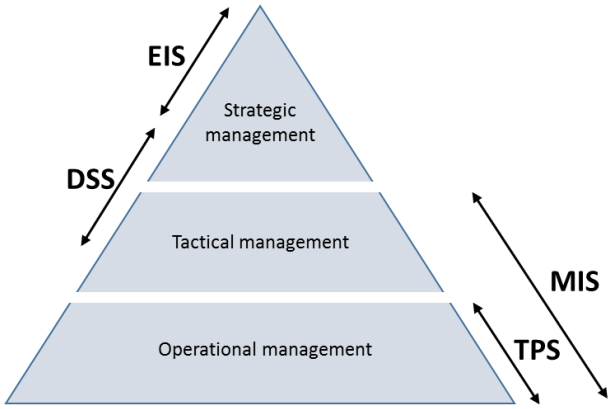

Figure 6. *Decision making levels and information systems (Davis & Olson 1985).*

It is up to interpretation, whether DSS or MIS surpass the decision making levels or is solely used by middle management in tactical decision making. The more relevant observation is that the focus of DSS is from tactical towards strategic decision making, whereas focus of MIS heads towards operational management. In this research the interest is in work/project/operational management and resource management, which leads our focus towards tactical and operational management. When taking this point of view into consideration, the greatest interest is especially in MIS, and how it is used and utilized in business operations and in previous researches.

2.3 Benefits of information systems

As discussed earlier, information systems can be used in many areas for various purposes in the organization to support the operations and managers' decision making, business monitoring and performance evaluation. Also Gurbaxani and Whang (1991) confirm this, when they state the different roles of information systems in an organization. These roles are: operations support, transaction processing, decision support, monitoring and performance evaluation, and documentation and communication channel maintaining (Gurbaxani & Whang 1991, p. 66).

The IS impact on operations (e.g. service operations) can be direct. This means that with the help of advanced information technology (IT), companies have been able to improve the quality of services/manufacturing, productivity and reduce operations costs. (Gurbaxani & Whang 1991, p. 66) As we mentioned IT, which is closely related to information systems, maybe it is wise to clarify the difference between these concepts. IT consists of devices, software and accessories that together form a delivery system (e.g. computer system with specific software application). Information system is a larger concept that consists of **IT and people** who use the IT delivery system. (Paul 2007, p. 194) In other words, information technology can be seen as a resource for information system, which is in line with Alter's (2002, p. 93) previously mentioned work system framework, where both information and technology are classified as resources.

The second IS impact area is transactions processing. The benefits of IS can be noticed especially in service industry, where basic transactions depend on information systems. The actual benefits include for example reduced inventory and labor costs. IS affects monitoring and performance evaluation by providing an effective tool to monitor for example business unit's performance records or even individuals' working times (began/finished the day). Another impact area is documentation and communication, where IT helps company to keep track of corporate status and business activities, and is essential tool to standardize business across geographically dispersed business functions. In addition, IT ensures that data is acquired and transferred into relevant decision making information, which further is crucial in internal coordination and communication. The final impact area is very apparent – decision support. The IS support ranges from information gathering to automated decision making systems. (Gurbaxani & Whang 1991, p. 67-68)

The documentation/communication impact is also one of the reasons in the case company of this research, why information systems and information technology are so important. The company has grown relatively fast through company acquisitions, which has resulted in various modes of operations on different areas. Business units are scattered around Finland, not to mention the differences between businesses in different countries. ISs assist in communication between business units and across borders, and enable to standardize the business. Standardization is significant, because it forces company's operations to function through the same procedure, which means that the services offered for customers are of uniform quality.

Nickerson (2001) has also listed several benefits on a general level that can be achieved with information systems. The first and probably most self-evident is better information that the organization is able to produce from the IS. With better information a manager is naturally able to do more reasonable and accurate decisions. IS can help organizations also to serve customers faster and with better information, which is related to the better service benefit. Time and cost saving can be realized in production and ISs can significantly improve the productivity. Cost savings and production efficiency are examples that also drive organization's performance forward and can be crucial factors that enable competitive advantage. (Nickerson 2001, pp. 23-24)

To better understand the impact/success of information systems, one approach is to look how the IS impacts are measured. According to Delone and McLean (2003), the overall IS success is affected by six factors categorized as information quality, system quality, service quality, (intention to) use, user satisfaction and net benefits. This so called IS success model is presented in Figure 7.

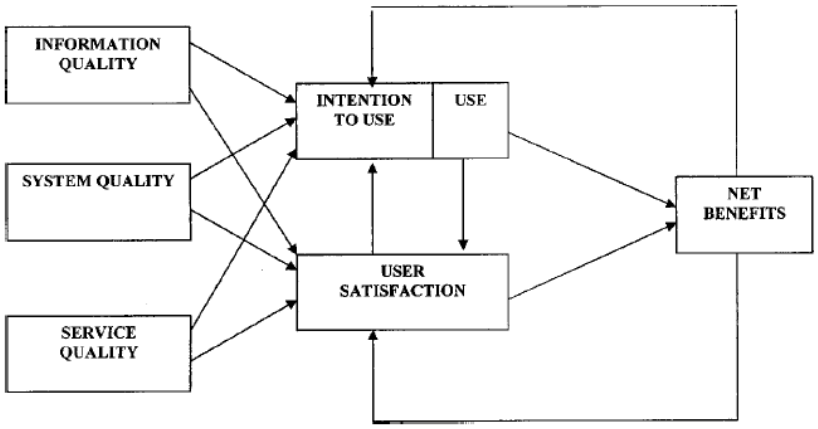

Figure 7. *Delone & McLean IS success model (Delone & McLean 2003, p. 24).*

The model includes three quality measures. Information quality includes indicators such as timeliness and relevance of information, whereas system quality is measured in terms of e.g. ease-of-use, functionality and reliability. Service quality is defined for example with tangible (IS has up-to-date software and hardware) and responsiveness (IS employees offer prompt service for users) indicators. (Delone & McLean 2003, p. 13-18) The arrows in the model illustrate associations among different success factors. Each quality measure/factor have an effect on IS usage and user satisfaction. The model does not specify, whether the effect is positive or negative, which is a relevant factor when we want to find out the final net benefits of the information system. The final net benefits could be e.g. cost savings or time savings.

Delone's and McLean's older IS success model (1992) focuses on two impacts levels of IS, which are individual and organizational impact. Jurison's (1996) view is parallel with this model. He stresses the fact that those success measures, which can be expressed quantitatively, are of most interest to managers. Information systems' impact on individuals is considerably easier to measure than impact on organizational level. The most common measure on individuals is the personal productivity improvement indicator, which could for example measure the time savings that are achieved with the information system. Jurison measured the organizational impact in terms of user perception and found out that the impacts are observable in longer term (after one year). (Jurison 1996, pp. 76-78) IS/IT could affect organization's structure, culture or flow of information, which are examples of organizational impact.

As stated, organizational impact is difficult to measure. Nevertheless, it is possible to define, how ISs affect organization and how organizations can achieve competitive advantage with ISs. Organizations face competitive forces (such as substitute services and new competitors/market entrants [Porter 1979]), which are counteracted with strategic choices. According to Laudon and Laudon (2007b, p. 80) information technology and systems enable the strategies such as: low-cost leadership, focus on market niche, product differentiation and strengthening customer and supplier intimacy.

The IS/IT projects fail to deliver the benefits that are pursued in the organization relatively often (Irani 2010; Coombs 2015). Coombs (2015) researched the reasons behind the underperforming IS/IT projects. The research target was a city council, which was implementing a financial management system to its operations. The pursued benefits included for example speed and accuracy of reporting, more efficient reporting, reduced paper flow, more relevant and reliable data, improved forecasting and ease of use of meaningful information. The realized benefits after implementation included only a few of the pursued benefits: more relevant and reliable data, timely data, faster reporting and reduced paper flow. The realized benefits were affected by facilitators and inhibitors. Facilitators include e.g. training on the use of the new system, whereas inhibitors consisted of e.g. low system performance in function response times and poor design of reports produced by the new system. When broadly equal levels of facilitators and inhibitors are present, the negative influence of inhibitors is tackled by the facilitators. (Coombs 2015) This example highlights the importance of change management in an organization. In order for the new system to be implemented efficiently and pursued benefits are realized, the inhibitors need to be mitigated efficiently. The training and inspiring of staff is crucial so that the staff engages with the new system as intended.

2.4 Information needs and usage

The information system usage (different IS types) has been clarified as well as the benefits that organizations are pursuing with various information systems. Now the interest shifts towards the information itself. How do organizations utilize the information / how is information (that is created in ISs) used? Naturally the information system usage and information usage are closely related concepts. ISs are used for example for decision making process, and information itself is the key to solve the actual decision making problem/problems. So IS is the upper level concept and information is the specific output (or part of it) of IS. In this chapter the purpose is to look deeper into the information usage/utilization situations.

Organizations use information strategically in three areas: to create knowledge for innovation, to understand the change in its environment, and to make decisions about business actions. When looking deeper into the decision making and specific information needs,

the decision maker needs complete information of organization's goals, feasible alternatives, probable outcomes and effect (e.g. financial impact) of these outcomes. At the same time should be remembered that in practice, the decision making could be muddled by the interests of stakeholders and negotiation between groups and individuals. Second strategical information usage area is the environmental change. The business environment is changing constantly, which affect organizations. This is why organizations need to be continuously alert, which requires information from their surroundings. (Choo 1996, p. 329-330)

The third strategical information usage area is interesting, because the information is used to create knowledge. Data, information and knowledge are often confused in practice, but these concepts have clear differences. The difference between data and information was already discussed earlier: information is processed data. When personal experiences are combined with information, knowledge is created. Knowledge and expertise is dispersed across organization and is often held by individuals or work units, which makes the knowledge management and usage challenging (Choo 1996, p. 330).

In their article, Skyrius et al. (2013) have put together the decision support process and relevant management information. The decision support process consists of six steps: accumulation of experience, use of experience, initial understanding of a problem, analysis, adequate understanding and decision. Information source and analysis tools form the supportive environment around the process. The user (of the process and information) is at the center and surrounded by knowledge. (Skyrius et al. 2013, p. 33) As stated earlier, knowledge consists of information combined with experiences. In decision making situations, especially in complex ones, making use of past experiences of oneself (and also colleagues) together with relevant information (gathered for example from information systems) is crucial for the analysis and understanding of the challenging decision making situation. The process is presented in Figure 8.

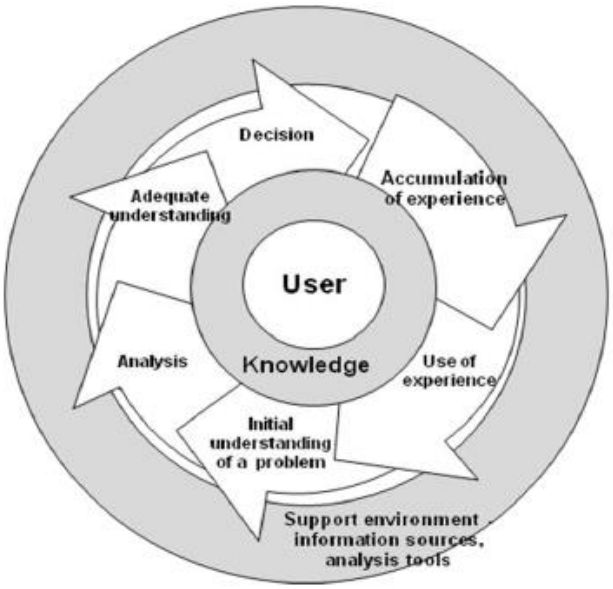

Figure 8. *The decision support system (Skyrius et al. 2013, p. 33).*

Certain information needs can be connected to each phase of the process. According to Skyrius et al. (2013), in the first phase of using experience (monitoring internal and external environment), simple and common information needs are present. When understanding to the decision making problem (might be a problem or opportunity) is constructed, special information needs arise. If the situation is complex enough, simple needs are complemented by complex needs in order to provide more information into the analysis and to construct a comprehensive understanding. The actual decision making phase involves the exploitation of existing understanding and newly developed understanding of the situation at hand. All available knowledge is used to make the best decision possible. The process of making a new decision creates new experience and special needs related to the process become common. Further, when that new experience is exploited and used, the process goes back to the first phase (monitoring/use of experience). (Skyrius et al. 2013, p. 33)

2.5 Information systems in project business

A project is an individual entity consisting of interrelated tasks that are executed over a fixed period. Especially in larger scale projects, the management of the project requires the support of a Project Management Information System (PMIS). This is an information system that is used to store and share relevant information about projects. PMISs are comprehensive systems that no longer focus only on project scheduling and resource management, but support the entire life-cycle of products, project programs and project portfolios (Ahlemann 2009, p. 19). Raymond and Bergeron (2007, p. 213) describe PMIS as decision making supporter for managers in planning, organizing and controlling projects. As could be deduced from the name project management information system, type wise it belongs to the management information systems (MIS). Thus, the main focus in decision making is on the operational and tactical management level, when looking at the relationship between decision making and information systems described by Davis & Olson (1985, see Figure 6). This would suggest that the information created in PMIS is mainly used in lower and middle level management to control and monitor the project regarding the everyday tasks. Nevertheless, it does not exclude the interests of higher/senior level management. For example, the status of the project need to be informed to higher management in order to satisfy its strategic responsibility (Cleland 2007). Figure 9 presents the PMIS location in the project management system. All the data related to the project combined with environmental/organizational data is processed in the PMIS in order to provide for example project manager, top management and customers with relevant information.

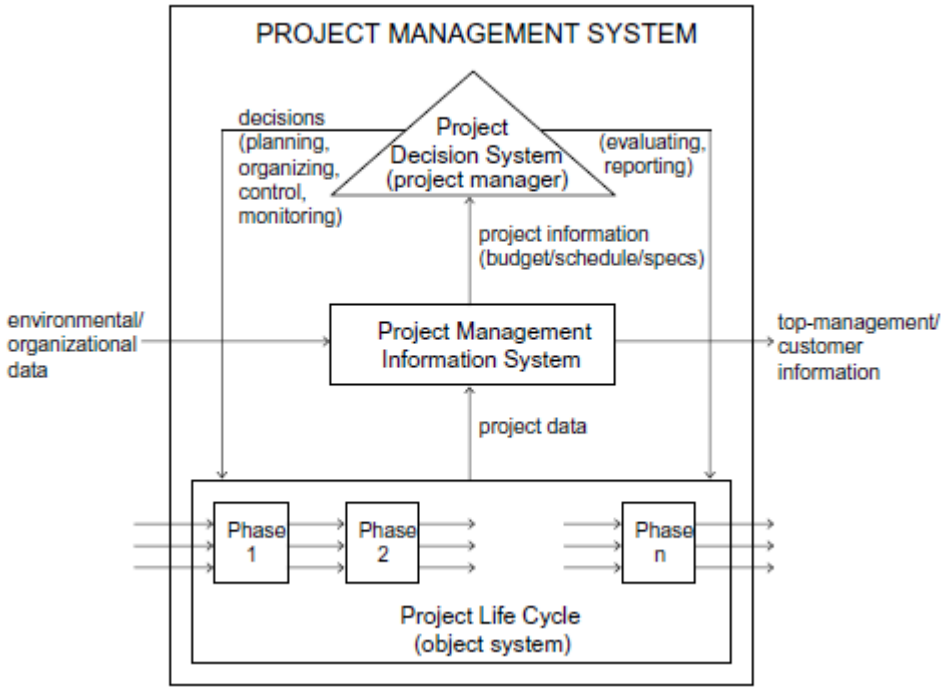

Figure 9. *PMIS in the project management system (Raymond 1987).*

Basically what constitutes a PMIS is a PMIS software and people that utilize the software. PMIS software perform various functions, such as project scheduling, resource management, budgeting, cost control and performance analysis (Nicolas & Steyn 2008, p. 475). Frigenti and Comninos (2002, p. 214) have some additions to this list of functions that an effective PMIS should include: generation of (ad hoc) reports and graphs, word processing, spreadsheets and various specific software and systems (such as materials and equipment management). Project scheduling includes for example the computing of early and late schedule times, slack times and the critical path. Resource management section performs resource loading, levelling and allocation to the project and activities. Fixed, variable and overhead costs handling, and costs estimation are part of the generation of budgeting reports. Cost control and performance analysis consists of comparing actual performance (actual costs and work completed) to budgeted performance. What needs to be noticed is that the PMISs and the various software in them vary greatly. Different software has different computing and reporting capabilities. (Nicolas & Steyn 2008, p. 460) However, the needs of managers also differ greatly depending on the nature of the project and business environment.

Project success rate is increased if project management methods (e.g. the Feasibility Study in project concept phase, the Product Breakdown Structure in planning phase or the Earned Value Management in implementation phase) are used (Kostalova et al. 2015, p. 96). Further, according to Kostalova et al. (2015), especially in more extensive projects including high demands, utilization of project management methods need the support from a project management information system. In their research, they assessed project management software applications and how they are utilized in practice. They found out

that freeware application and free cloud tools are only applicable to smaller budget uncomplicated implementation cases. In more complex cases, a software application such as MS Project or Primavera are tools that are more appropriate.

2.6 Information systems and business performance improvement

Chapter 2.3 discussed the general benefits of information systems. Here the purpose is to connect the information system and business performance: what is the effect of information systems on business performance? Business performance refers to how well a company is performing against certain standards or goals. To determine the company's performance level quantitatively, measures or indicators have to be created in order to have results that can be compared to the standards or goals. Lipaj and Davidavičienė (2013) investigated this interesting topic of "information system influence on business performance" in their research. They demonstrated that business performance lies in between a business strategy and information system. This suggests that company's strategic goals are pursued through an information system, which would result in increased business performance. Lipaj and Davidavičienė also suggest that information system impact on business performance could be defined by the analysis of tangible and intangible benefits.

Lipaj and Davidavičienė (2013) concentrated especially on the tangible and intangible benefits of an ERP system. These were compiled from several previous researches. Their results show that growing need of information requires information systems, and through these system solutions businesses can have improved business management methods and operational productivity, which would eventually result in competitive advantage. Another crucial impact of information systems is on the business processes: whether it is an production process, customer service or accounting, information systems are used to achieve a higher efficiency in these processes. Lastly, ISs can help to identify and resolv problems and weaknesses of a company. (Lipaj & Davidavičienė 2013, p. 44) This is quite easy to understand, because information systems are used to e.g. store and analyze the data related to projects, and based on the analyzation the system can bring up signals (negative or positive) related to for example cash flows, profit margins and variable/fixed costs.

Ravichandran et al. (2005) studied the effect of information systems resources and capabilities on firm performance, so they had a resource-based view in their research. Their findings show that IS resources and IS functional capabilities are critical determinants of how information technology is implemented in the organization, and this will further affect also firm performance. IS functional capabilities (which can be divided into planning, system development, IS operations and IS support capabilities) affect greatly to organization's ability to use IT to support its core competencies. If the organization is able to

use IT to improve activities connected to core competencies, it has potential to also improve firm performance. Ravichandran et al. (2005, p. 258) found out that if organization have failed to develop IS capabilities or invest in IS resources, they find themselves lacking necessary capacity to leverage IT in the creation of competitive positions.

3. UTILIZATION OF INFORMATION SYSTEMS IN BUSINESS OPERATIONS

The goal in this chapter is to connect the information system topic to the areas, which are of interest from this research's point of view. Thus, the purpose is to look deeper into project monitoring and project management information needs, information utilization in resource management and vehicle tracking/management information systems usage. These ISs are especially interesting in this research, because the objective in the case company is to improve project and job management (implementation, monitoring and reporting), resource management (resource planning, support from PMIS), and field work monitoring and logistics (information provided from the vehicle tracking system). It is beneficial in each business area topic (project/work management, resource management and fieldwork monitoring/logistics) to describe how these processes are controlled and how information systems could contribute to capturing the needed information in those processes.

The focus point in this study is in business units and their operations, because the actual work is managed in those units. Business units are the targets for development and when improvements for example in reporting are made in the units, the results reflect positively also to the reporting in upper organizational levels. With relevant information gathering from ISs, the goal is to improve the work/project management in business units and improve the reporting and monitoring of those projects as well.

3.1 Project monitoring and control

As the research questions in this thesis are concerned about the information collected from processes and information systems, one crucial area to look into is project management and especially project monitoring and control. Project monitoring and control includes the managerial information needs and questions such as: what information is relevant to find out about projects? What are the reporting needs related to project monitoring? What information is needed to measure the project performance?

In the core of project monitoring and control procedures lay three main dimensions/parameters: schedule, cost and quality. The project performance measurement (discussed also later in this chapter) depends heavily on these three factors. Thus, a key part of project monitoring and control is to manage and control with certain procedures and with the help of certain tools these main parameters. Hormozi and Dube (1999, p. 35) state that project schedule can be controlled with the help of information systems and project software. Gantt charts are especially efficient and useful tools to manage the schedule. Cost controlling includes reports related to actual vs budgeted expenditures. Quality control

procedures on a basic level include making sure that the project activities are performed according to technical standards and guidelines. (Hormozi & Dube 1999, pp. 35-36) An important factor related to quality control is how the work in managed in the units: Are the task responsibilities clear? Do individuals have possibilities to plan and control their tasks? In the end, high quality is very much related to performance of individuals, so task responsibilities and work instructions need to be clear in order to achieve the quality requirements.

Knutson and Bitz (1991) have listed five stages that are part of the operational project control process: (1) Update past status; (2) Analyze the impact of new changes; (3) Act based on the variance between actual and planned performance; (4) Publish schedule changes; and (5) Inform senior management. So everyone involved in project tasks need to be on track of the project status and react quickly to possible changes. All the factors affecting key measures such as schedule, cost and quality need to be noticed and corrective actions planned in order to keep the project performance inside acceptable boundaries.

3.1.1 Project management information system effect on decision making

There have been several studies in the literature about the perceived usefulness of PMIS and the effect of PMISs and software on manager's decision making (Ali & Money 2005; Caniëls & Bakens 2012; Raymond & Bergeron 2008; Saeed & Abdinnour-Helm 2008). Each of these studies created several hypotheses related to their research and tested those hypotheses by conducting questionnaires and analyzing the results. The most significant similarity between these studies is related to the PMIS information quality and its effect on project managers and use of PMIS. Ali and Money (2005) found a strong correlation between the perceived PMIS information quality and the use of PM software. Also Raymond's and Bergeron's (2008) findings support the positive impact of information quality on the usage of PMIS. In addition, they found a positive correlation between PMIS information quality and its impact on project managers. Caniëls and Bakens (2012) and Saeed and Abdinnour-Helm (2008) also can agree with this finding, because the first research couple found a strong correlation between PMIS information quality and project manager satisfaction with PMIS, while the latter research partners showed that information quality is a significant predictor of user perceptions regarding the usefulness of IS.

Reliability, relevance and accuracy of the PMIS information has a significant impact on the quality of decision making, and this applies especially to multi project environment, where several projects are managed simultaneously (Caniëls & Bakens 2012, p. 171). This means that the reports generated in PMISs must be targeted to the right interest group and the information has to answer to the decision making problems and/or satisfy the needs of stakeholders (relevance and accuracy). It should also reflect the business and be

constructed of factual data (reliability). In order to produce quality information through PMIS, the system has to work properly. According to Raymond and Bergeron (2008, p. 218), the system's ease of use, learning ease, flexibility, response time and integration to operations and other organizational information systems has an important role in creating high-quality information. It should be noted that the system itself does not have direct influence upon project success, but the success is achieved through the use of the system and creation of high-quality outputs/information (Raymond & Bergeron 2008, p. 219).

3.1.2 Project stakeholder information needs

There are various stakeholders that are connected to projects: a customer, senior management, project manager, functional manager (responsible for specific function of the project) and project team member. The information needs can vary depending on the stakeholder observed. Information regarding the status of the project is a rare example of the type of information that interests all stakeholders. (Cleland & Ireland 2007) However, the specific information inside the status reports varies depending on the audience (Biafore 2011). For example, senior management is greatly interested in financial results of the project and actual costs vs. budgeted costs, whereas the project team members are more interested in technical execution and status of the work they are doing.

From management stakeholder (executives) perspective, the project status report should include high-level performance metrics and project accomplishments: major milestones completed, summaries of costs, schedule performance (is the project on schedule and what are actuals costs vs. budgeted costs) and risks affecting the project. Functional managers and team members need mainly information considering the status of the work done and when the tasks will be completed (emphasis on schedule and completed tasks vs. all tasks –indicator in percentages). (Biafore 2011) Team members communicate the status of the tasks to functional managers and project manager, whereas project manager communicates the financial results and other key status information to senior management and customer. Besides the current status of the project, project managers need information considering the possible changes in the project in order to manage the changes and communicate them to upper management levels and customer. The changes in the project could include e.g. changes in costs, schedule, resource requirements or new project requirements (Cleland & Ireland 2007).

Cleland and Ireland (2007) divide the information provided by PMIS into four categories: Organizational support information, historical information, current project information and old information (files) from the current project. Organizational policies and procedures for project are examples of organizational support information. Historical information could include proposals, quotes, bids of the project and also budgets, schedule and technical performance of previous projects. Current project information includes naturally all the timely information that is collected from the undergoing project, such as task

schedules, budget, resources, statement of work, communication plans and risk assessments. Old files or old information related to the current project refers to e.g. closed out contracts and superseded materials, policies or procedures.

Nicholas and Steyn (2008) discussed more closely about the reports that should be send to:

- Top management and the project management office
- Project, program and functional managers
- Customers

Top management and the project management office and their needs should be satisfied with monthly progress reports that contains

1. Project status summarization (statement)
2. Red flag items, which indicate that corrective action has or should be taken
3. Accomplishments, changes to schedule and projections for cost and schedule at the completion date of the project
4. Current and potential problems and action statements that tackle the them
5. Current cost status and cost performance
6. Resource plan and limitations (Nicholas & Steyn 2008, p. 458)

Project or program managers receive reports about the value of work completed, current and forecasted costs and updated schedules for completion. In addition, they receive financial status reports about costs incurred and cumulative budgeted costs vs. actual costs. For functional managers are also offered reports showing labor-hours and expended costs for work under their area of responsibility. Naturally, also customers need to be kept on track and provided with monthly reports. They are especially interested in work progress and possible changes on work scope, schedule or cost. Clear and understandable customer communication is crucial, and it is project manager's responsibility to make sure the customer is informed appropriately and according to contractual terms. (Nicholas & Steyn 2008, pp. 458-459)

Web-based reporting tools are receiving popularity in today's modern business. There are various web-based software as a service (SaaS) type of solutions that are used to analyze the business data and generate reports that satisfy the needs of managers. The most significant and self-evident benefits of these so called business intelligent (BI) SaaS are the cost-effectiveness and schedule-effectiveness in implementing the solution. When choosing a SaaS based solution, organizations free themselves from designing and building an IT infrastructure (Thompson 2009, p. 55).

3.1.3 Project performance measurement

Project performance measurement is an area under project monitoring and control that reveals what project related information is interesting and should be collected. Performance measurement is closely related to previously introduced needs of stakeholders. Managers are interested in how the projects are performing, i.e. current state of the project. Performance measurement systems are created to satisfy the monitoring needs of stakeholders. This sub-chapter focuses to present relevant performance measures (key performance indexes), frameworks and analytical tools in order to capture the information that should be gathered from processes.

There are several managerial purposes for measuring performance on general level. Behn (2003) has identified eight of them in total:

1. Evaluate
2. Control
3. Budget
4. Motivate
5. Promote
6. Celebrate
7. Learn
8. Improve

These purposes do not apply only on general level, but they could be reflected also to project management environment. The first three purposes are clearly connected to the actual work and its monitoring and control. In project management this would include evaluating the individual and group performances with project tasks, controlling the tasks and resources in order to make sure the right people are doing the right tasks, and finally defining the project budget, allocating it to tasks and controlling the actual costs vs. budget. Motivational, promotional and celebration purposes are on the other hand related to social and cultural factors. It is about inspiring staff, convincing other stakeholders and rewarding success through the performance measures. The last two purposes have the development point of view. Problems and mistakes need to be identified and solved in order to achieve improvement and make sure that in the following projects the same mistakes are avoided.

One of the most well-known performance measurement frameworks is the balanced scorecard (by Kaplan & Norton 1992). Balanced scorecard is a strategic performance tool that translates company's vision and strategy into objectives. It is known to be used especially in operations management, but it has perspectives that are relevant also in project management. The framework consists of four perspectives: financial, customer, internal business process, and learning and growth perspective. Each of these contain specific objectives, measures, targets and initiatives. When reflecting this framework to the study

at hand, the measures of financial and internal business process are especially interesting, because the purpose is to find relevant information of business processes in order to develop the operational performance. Financial measures reveal to stakeholders how the target (in this case the project) is performing in revenue and cost figure wise. Internal business process measures on the other hand focus on operational measures on the actual work level.

Neely et al. (2000, p. 1120) state that balanced scorecard –framework provides us the measurement areas which are of interest to managers, but it does not provide guidance on how to identify the appropriate measures. Because the specific measurement indicators are situational, in their research Neely et al. (2000) used brainstorming sessions with managers to determine the appropriate measures. The sessions resulted in a list of possible measures, which was then further evaluated with cost-benefit analysis, and comprehensiveness and relevancy check sheets. Since Neely's and co. research, Kaplan and Norton have written a couple of articles, where balanced scorecard is put to the test in practice. They used an example of a semiconductor company called ECI, for whom they created a balanced scorecard. This scorecard included measures considering the cash flow, quarterly sales growth, operating income by division, increased market share and return on equity from financial perspective. Internal business perspective related measures were e.g. cycle time, unit cost and yield respectively. (Kaplan & Norton 2005) These measures are especially applicable to evaluate the performance of business units. Though, the main focus is on the monitoring and control of individual projects, because in order to develop the measurement of BUs, individual projects need to be managed and measured comprehensively.

Morris and Pinto (2010, p. 76) list measurement areas, which are characteristic for project performance measurement:

- Project scope (percentage completed)
- Time (schedule)
- Cost (consumption of resources/work force)
- Risks
- Quality
- Satisfaction and attitudes of stakeholders (project team, managers, customer etc.).

As stated earlier and as Morris and Pinto (2010, p. 78) confirm, what can and should be specifically measured varies depending on the project type and perspective of the organization. Still, the general decision cycle of performance measures is relevant in every situation. It involves deciding what and how to measure, comparing the measurement data to targets/standards and taking action based on the comparison results. This simple cycle is presented in Figure 10.

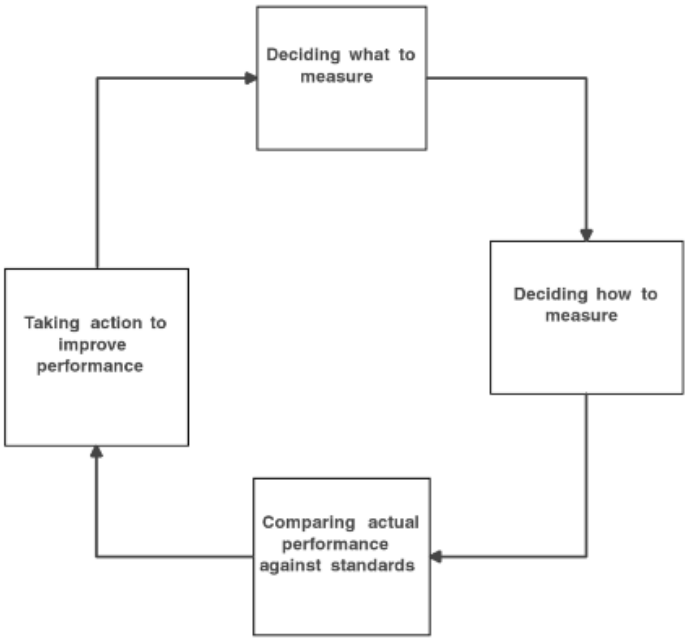

Figure 10. *Performance measurement cycle (Morris & Pinto 2010, p. 78)*

Alarcón and Ashley (1996) presented another performance measurement approach called general performance model to evaluate construction project performance, which includes drivers (variables affected by project options), processes (functional characteristics of construction projects) and performance outcomes (measures that are useful for decision maker). They divided the performance measures into four categories: costs, schedule, value and effectiveness. Costs and schedule measure categories are self-explanatory and included in majority of project performance measurement systems and models. Value measures evaluate the fulfillment of owner's needs and basically evaluates the business benefits from the project. Effectiveness measures takes a stand on the project's implementation success. (Alarcón & Ashley 1996, p. 267)

Besides various frameworks and models to evaluate and measure the projects, key performance indicators (KPI) are widely used to assess the performance of a project. KPIs are the central measures that define how the project is functioning. The use of KPIs do not limit only to projects, but they could be used to assess for example the overall performance of a business unit. That being said, this chapter focuses on the project performance measurement. Key performance indicators reveal the relevant information that should be collected from project related business processes in order to satisfy the needs of managers.

There has been several researches in the literature considering the KPIs related to construction projects (Cox et al. 2003; Yeung et al. 2007; Luu et al. 2008; Rankin et al. 2008; Linget al. 2009; Skibniewski & Ghosh 2009; Swarup et al. 2011; Almahmoud et al. 2012; Yeung et al. 2013). Construction business is fairly similar in nature compared to the business of the case company in this study: the company offers manpower for customers to perform a certain task or project at the customer's site. Thus, construction project related KPIs are relevant from the viewpoint of this research. Yun et al. (2016) have collected the offering of these previously mentioned construction project researches and listed the KPIs or the measurement areas that the KPIs are connected to. This list of KPIs and respective researches are presented in Table 2.

Table 2. *Summary of KPIs from previous researches (Yun et al. 2016).*

KPI	*Cox et al. (2003)*	*Yeung et al. (2007)*	*Luu et al. (2008)*	*Skibniewski & Ghosh (2009)*	*Rankin et al. (2008)*	*Ling et al. (2011)*	*Swarup et al. (2011)*	*Almahmoud et al. (2012)*	*Yeung et al. (2013)*
Cost performance	X	X	X	X	X	X	X	X	X
Schedule performance	X	X	X	X	X	X	X	X	X
Quality performance	X	X	X	X	X	X	X	X	X
Safety performance	X		X	X	X			X	X
Customer satisfaction			X	X		X	X	X	X
Change (scope) management			X					X	
Productivity	X			X					
Profitability				X		X			
Sustainability					X				X
Effective communication		X							X
Innovation and improvement		X			X				
Unit cost	X								
Top management commitment		X							
Trust and respect		X							
Project team			X						
Material management			X						
Predictability of cost and schedule				X					
Public satisfaction						X			
User's satisfaction									X
Functionality									X
Planning effectiveness									X

As can be seen from the table, all of the researches have stated that cost, schedule and quality performance are key measures to evaluate the performance of a project. Cost, quality and time are so central and popular measurement areas to evaluate the success of the project that they have been given the name Iron Triangle (Atkinson 1999, p. 338). However, according to Atkinson (1999), these Iron Triangle measures require guessing, because they are usually calculated when small amount of information is available regarding the project at hand. This opens possibilities for errors, which need to be tackled with supportive performance indicators. As the table above reveals, plenty of KPI areas have been discussed and identified that support the Iron Triangle. Safety performance and customer satisfaction measures are the most distinctive ones from the list. In addition, there are several qualitative and personnel related – such as top management commitment, project team, trust & respect and end user's satisfaction – indicators.

To conclude, project management information systems are used to plan, organize and control projects. PMISs need to provide managers with relevant and timely reports on how the projects are performing. The relevant information depends naturally on the needs of the stakeholders and the business environment. As Nicholas and Steyn (2008, p. 458) stated, the (monthly) reports should contain e.g. summarized status information of the project, cost performance, accomplishments, action points, problems or risks and possible changes. Project performance measurement and key performance indexes also reveal the relevant information that should be captured through PMIS. This information includes especially the time, cost and quality performance measures. These indicators could and should be supported with additional performance indicators, such as profitability, productivity, customer satisfaction and safety performance KPIs. When looking specific project management tools, EVA framework stands out with its popularity and ability to evaluate the status of the project through clearly defined parameters.

3.2 Information utilization in human resource management

The second question of this research is related to the resource management (human resource management) and is interested in the information that should be collected from business processes. This chapter aims to find opinions from the literature on the information needs in human resource management. The goal in the case company of this thesis is to develop the resource allocation to different tasks under projects and be able to predict the future resource needs earlier and more accurately. This goal is closely related to the new project management information system, which ties the resource management subject with the project monitoring and control. Human resources (e.g. technicians and fault repairers) are managed and allocated to tasks in the work management system, but the resource reservations should be visual also in the project management system. The work and project management systems are integrated systems and communicate with each other.

Under human resource management topic, the greatest interest is in the human resource planning i.e. workforce planning. Basically the objective of workforce planning is to match the supply of and demand for employees from strategic level to an operational level (Stolletz 2010, p. 414). The focus of strategical resource planning is towards longer-term demand forecasting, while operational planning is concerned about short-term work requirements of day-to-day operations in the near future (Manzini 1988, p. 79). According to Dietrich (2006, p. 62), key processes in the planning of human resources for business services include:

- Forecasting demand for services (e.g. the number, size and content of contracts)
- Forecasting the time-phased demand for the resources that are used to execute the services
- Cost evaluation and constraints determination related to acquisition, training and termination of resources
- Evaluation of resource allocation to activities (forecasted demand of services as a base)
- Pricing for business service contracts (including service level agreement [SLA] specification)

Workforce planning is considered essential to high-performing organizations, but it has some barriers, which make it hard to launch within HR. First barrier is the period of workforce planning. It addresses a longer period, so the achievements are not necessarily visible in the current year's result. Managers on the other hand are focusing mainly on the areas that affect current and near future results. Another barrier is forecasting, which includes methods that are not sufficient to predict the individuals at risk for turnover and retirement. In addition, there are barriers related to the managers' impressions considering the integrity and usefulness of gathered data. (Louch 2014, p. 4)

Effective human resource planning requires attributes that are used to categorize the human workforce, and analyzation of the value of flexibility within organizations and workforces (Dietrich 2006, p. 64). This means that organizations need to have a clear understanding of the capabilities and skills of their workforce in order to realize, how many resources they have per certain type of service. Forecasting demand for services and workforce planning (meaning human resource need evaluation) are discussed in more detail in the following sub-chapters.

3.2.1 Demand forecasting

In order to effectively evaluate the need for different types of human resources, the demand or sales for various services need to be first forecasted as accurately as possible. Forecasting methods can be divided into two main technique categories: qualitative and

quantitative forecast methods (Abraham & Ledolter 2009, p. 2). Qualitative methods are subjective as nature, whereas quantitative techniques are based on mathematics and statistics. In order to plan the human resource needs accurately, an annual sales budget calculations are needed to determine the sales per service. Further, based on the budget calculation can respective resource needs calculated to make sure that customer demand can be matched with organization's supply.

There are four different processes to forecast sales in an organization. These processes are gathered to Table 3.

Table 3. *Alternative processes to forecast sales (West 1994, p. 398).*

Sales forecasting process	***Definition***
Bottom-up	Managers in sub-units establish the forecast.
Bottom-up / top-down	Managers in sub-units establish the forecast. Top management adjusts the forecast to match it with the organizational goals.
Top-down	Top management establishes the forecast.
Top-down / bottom-up	Top management establishes the forecast. Sub-units adjust the forecast according to their goals. Top management co-ordinates the final forecast.

So the initiative to forecast sales is made from either management or sub-units. Depending on organizations, the perspectives of both top management and middle management can be included to forecast the final sales budget.

According to Pilinkiené (2008), qualitative forecasting methods – which are for example based on manager's or expert's judgments – are especially suitable for demand forecasting in new markets, because the data from previous periods is not necessary. On the other hand, the downside is that qualitative methods do not take seasonal or trend related fluctuations into account. (Pilinkiené 2008, p. 21) This is why the interest shifts more towards quantitative methods. The raw sales forecasting is wise to make with quantitative methods in order to take seasonal fluctuations into consideration, but this forecast could still be evaluated and adjusted with judgmental methods.

To choose the right quantitative forecasting method, one way is to look at the time span that is being forecasted. Simple moving average and exponential smoothing techniques

are fitting to forecast short- (1-3 months) and mid-terms (3 months-2 years), while regression models are applicable for over 2 year's forecasts. Other factors that affect the forecasting method choice are desired accuracy, costs, amount of necessary initial data and result implementation level. (Pilinkiené 2008, p. 21)

3.2.2 Workforce planning

Workforce planning includes two central components: demand planning and supply side analysis (Louch 2014, pp. 5-6). Demand planning determines the head count for each type of job role, so this is the component where the sales forecast data is crucial. Managers need to know the future demand for their products in order to decide, what is the proper staffing level per each job role. The purpose of internal supply analysis is to check whether the supply can satisfy the external demand on quantitative and qualitative basis (Louch 2014, p. 6). Quantitative point of view includes evaluating the talent supply by job role after attrition (turnover, retirement and internal movement between jobs), whereas qualitative perspective consider the capabilities and performance of workers. Based on these evaluations and comparison of them to the demand requirements, a gap analysis can be created, which reveals the manager possible gaps between the demand and supply for certain talent and job type.

Workforce planning requires data gathering from several sources and an analyzation of that data so that useful information could be created for management. Armstrong and Taylor (2014, p. 219) have listed four data categories, under which the gathered data drops:

- Qualitative internal data (e.g. product market development, organizational changes, skills of workforce)
- Quantitative internal data (e.g. workforce related data on turnover, absence statistics)
- Qualitative external data (could include the usage of tools such as PESTLE analysis, which considers the following factors: political, economic, social, technological, legal and environmental)
- Quantitative external data (labor market demographics and availability of skills)

The same way as material resources that construct a product can be listed (bill of materials i.e. product structure), bill of resources can be determined for services. For example, the data of labor hours reported in IT projects could be utilized in creating a bill of resources template that is used to estimate resources requirements for future similar projects. What is challenging in resource planning and allocation though is that in services there is generally a higher possibility to substitute one resource for another. Therefore, information

systems that support resource planning need to represent the variability of task work content and delivery rates. (Dietrich 2006, p. 64)

There are some long-term general strategies to capacity management that does not apply only to manufacturing environment, but service operations as well. “Level capacity” strategy refers to an operation, where the capacity is kept at a constant level regardless of the demand pattern. If the capacity is changed frequently and set to follow the demand pattern as closely as possible, this strategy is called “chase demand”. Another strategy called “demand management” aims to influence – instead of capacity – on the demand pattern itself to match it to the capacity level. (Olhager & Johansson 2012, p. 25)

In many cases service providers do not have enough capacity of their own, so they need to buy capacity from external providers. In this case the service provider may have a few options or models of capacity supply (MCS) to choose from. Dorsch and Häckel (2014) studied a business process vendor, who had three different external capacity options: dedicated capacity, elastic capacity and surplus capacity. Dedicated capacity option means that the service provider reserves ex ante a specific level of capacity and pays for that capacity regardless of whether it is used or not (pay-per-capacity pricing). This capacity model most likely involves either excess costs or lost revenues depending on the demand level. In case of elastic capacity model, the service provider pays only for the capacity that is used. Here the pricing is “pay-per-job” type, so the vendor pays an agreed amount per customer request (which is often relatively high). The last model – surplus capacity – also follows a “pay-per-job” pricing, but the capacity is bought from external providers’ market. This way the service provider can change external providers more dynamically and in addition, surplus capacities are usually offered at a lower price. (Dorsch & Häckel 2014, p. 4) To decide the overall appropriate capacity level is very challenging, especially for organization that face greatly varying demand. Naturally, the goal for the service provider is to minimize the customer waiting time and idle capacity.

To summarize, effective workforce planning and the appropriate staffing level determination need a clear process structure behind it. All the steps to make the resource plan for business unit for the future are needed to be clarified accurately. The demand for business unit’s services work as a basis for human resource planning. The organization uses according to their preference either qualitative or quantitative methods (or mixing both) in order to make the budget for future months. This monthly budget is then utilized to evaluate the number of service activities and further, the ideal number of fieldworkers for incoming months.

3.3 Vehicle monitoring system utilization in business operations monitoring

Another information system that can be utilized in business unit management is a vehicle monitoring system. These systems are usually used to monitor, how the organization's vehicles move on the field and especially, how the drivers are using the vehicles and driving them. Vehicle monitoring system utilization does not limit only to monitoring purposes, but it can also provide benefits in logistical decisions.

The tracking of vehicles is based on a device that is installed to the vehicle. Through wireless network the installed device interacts with a software that collects the data sent by the device. In order to find out the exact location of the vehicle, GPS (Global Positioning System) tracking technology is used. Aydin et al. (2015) studied vehicle tracking system utilization in public organizations. In their case the mounted vehicle tracking devices included both GPS and GPRS (General Radio Packet Service) modules. GPS module communicate with the satellite in order to get the location data, and that data is then sent with GPRS modules to a server. (Aydin et al. 2015, p. 511)

In Aydin et al.'s research case the vehicle tracking and management system composed of three parts: active vehicle tracking, insurance & inspection procedures and maintenance section. With active vehicle tracking it is possible to e.g. see active vehicles working and monitor fuel costs and total kilometers driven. Insurance and inspection procedures include the monitoring of insurance and inspection fees and their payment timetable. Lastly, maintenance reporting gives valuable information regarding the periodic maintenance activities of the vehicles. Overall, these three system modules proved to provide significant benefits in the public case organization. For example, the car costs and corporate expenses dropped 25 % and the number of total driven kilometers decreased from 45 000 km to 35 000 km. (Aydin et al. 2015, pp. 514-516)

Indeed, there are many success stories where vehicle monitoring systems are utilized to improve the performance of business operations. Engebretson (2005) discussed a few successful cases in his article. A security company adopted a vehicle tracking system that tracts the fleet vehicles every 10 minutes and gathers information for example of over speeds and notifies management if vehicles are used outside of working hours. The results show that the vehicle tracking service can easily pay back its use with the savings in overtime, gas and unauthorized use of vehicles. Another security company faced problems where the fieldworkers were coming to customer site too late and leaving early. Vehicle tracking system provided accurate information of arrivals and departures, which helped to solve the problem. In addition, when the system shows the exact locations of fieldworkers, the work coordinator can easily handle urgent and unexpected situations in a certain location and navigate the closest workers to the site.

Vehicle tracking systems' another impactful area besides field work monitoring is logistics. Vivaldini et al. (2012) studied the features of tracking systems and fleet management applications and how they can improve Logistics Service Provider's (LSP) deliveries for customers. In their research the case LSP utilized the vehicle information system in fleet monitoring and services management. Monitoring allows the company to track the movement of their vehicles, the driving behavior and whether the driving routes are carried out according to the plan. The fleet management system can also provide accurate information regarding for example the delivery points and their times, and create reports including quality complaints and delivery specific performance information. (Vivaldini et al. 2012, pp. 553-555)

The monitoring and analyzation of driving routes is especially beneficial from logistics point of view. With optimized routing can significant time and cost savings be achieved. Everything that is saved in transportation times, can be shifted and added to the actual service tasks. As Vivaldini et al. (2012, p. 557) also state, for example delays can be seen in real-time and how deliveries have gone that specific day. In addition, from maintenance service providers point of view, vehicle tracking system assists in handling urgent fault repair tasks with location information of the nearest technician. The practical benefits and effects of vehicle tracking system for service provider are discussed in more detail later in the discussion section of this thesis.

3.4 Tentative framework on the use of delivery process information in developing business performance

Based on the previous theory, a tentative framework/construction needs to be created. The purpose is to gather the areas of interest based on the research questions, and connect the previous theory to those areas.

Project management and resource management are the key areas that are in the focus point of this research. The purpose is to find out the key delivery process information that should be of interest for business unit managers in project/work/business unit/resource management. Crucial part in information management and delivery is the role of information systems, which means it is the central part of the construction too. The overall goal is to improve the performance of the business units by gathering the correct information from the delivery process and utilizing it to manage the business unit and the key operations (projects, jobs, resources) more efficiently. Consequently, the tentative framework takes the following shape (presented in Figure 11).

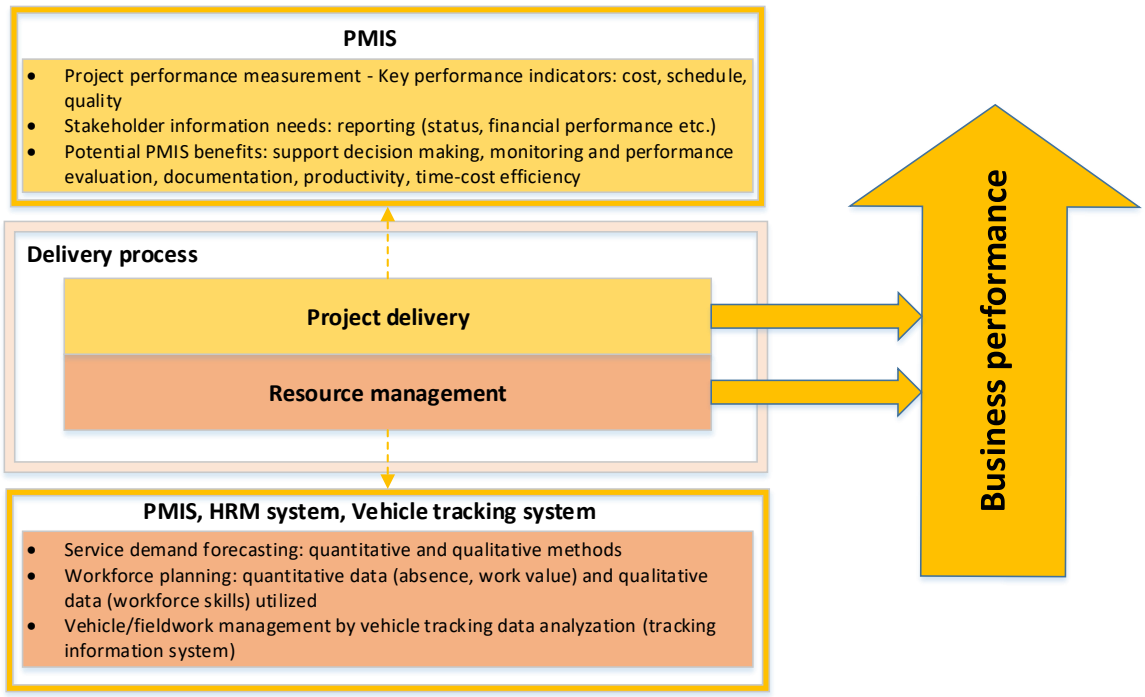

Figure 11. *Tentative framework on the delivery process information usage and IS utilization to improve business performance.*

As ***the***

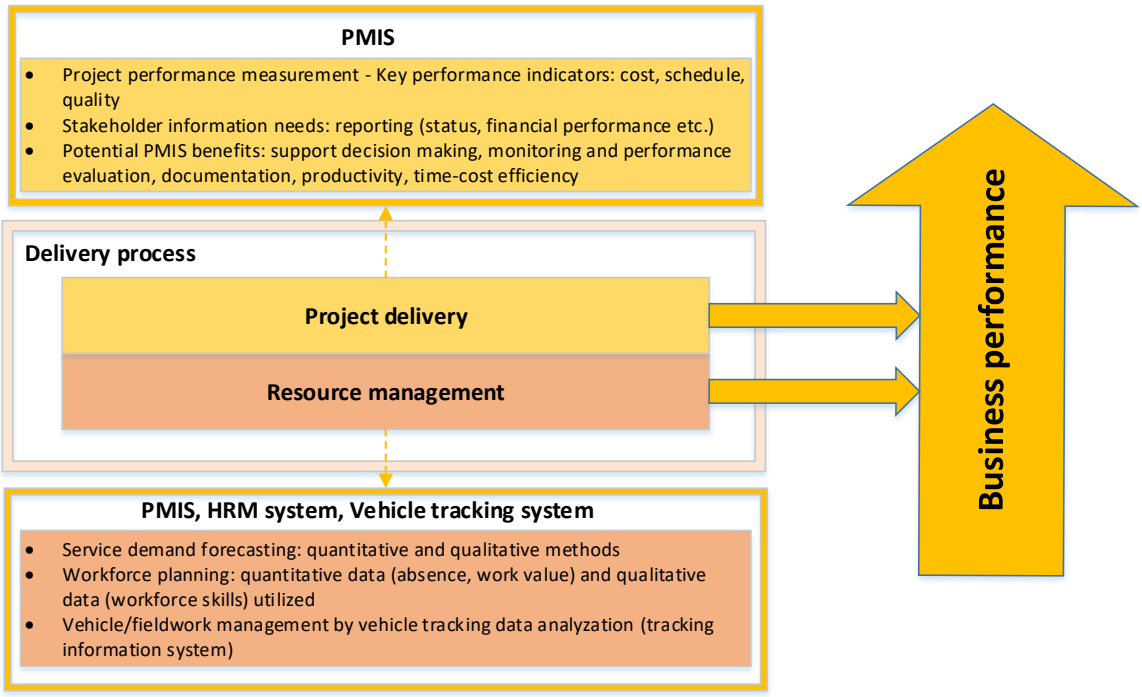

Figure 11 shows, information systems (PMIS, vehicle tracking system, HRM system) handle the information created in the delivery process. The delivery process itself consists of the two processes that are of interest – project type deliveries and resource management. As the theory revealed, with PMIS it is possible to achieve several business benefits. Resource management section focused on the forecasting and workforce planning processes and highlighted the importance of clear process structure behind those methods. Effective demand forecasting and resource supply side planning requires collection of quantitative and qualitative data. The more information is gathered and handled, the more important is the role of the information system. ISs have a great potential to improve businesses documentation, communication, monitoring of projects, performance evaluation, decision making and time-cost efficiency. ISs are crucial IT tools that are utilized to execute company's strategic goals. Ultimately, when this execution is done correctly and ISs are utilized to full potential (whether it is about improving certain business methods, creating higher efficiency in certain processes or support activities with ISs in core competencies), business performance can be improved.

4. RESEARCH METHOD

In this chapter the delivery processes and IT systems of the case company are first presented. The information which is of interest is gathered especially from delivery processes and IT systems connected to them, so it is essential to introduce these topics in order to understand the results achieved comprehensively.

For this constructive research there are three different perspectives that are of interest: project and task monitoring and control, resource management/planning and fieldwork monitoring/logistics. The goal is to improve case company information management in these areas and present a framework including key delivery process related information and aspects that can be utilized to improve business performance.

The constructive research approach fits to this context very well, because the purpose is to create a model/process description/report that improve the operational performance and satisfy management needs. The creating of this kind of models, frameworks etc. is the core of constructive research approach. As Oyegoke (2011, p. 578) describes, "constructive research is used to define and solve problems, as well as to improve an existing system or performance, with the overall implication of adding to the existing body of knowledge".

4.1 Key processes and process activities in the case company

Case company's sales and delivery processes are similar across different divisions. So, for example Telecom Network division's delivery processes follow the same steps as Power Network's, but there is difference in the tasks that are related to the sub-processes under those delivery processes. Starting from the upper process level, Figure 12 shows the connection of sales and delivery process. Because the focus in this thesis is on Telecom Network division, it is used here as an example, even though these same processes apply also to other divisions.

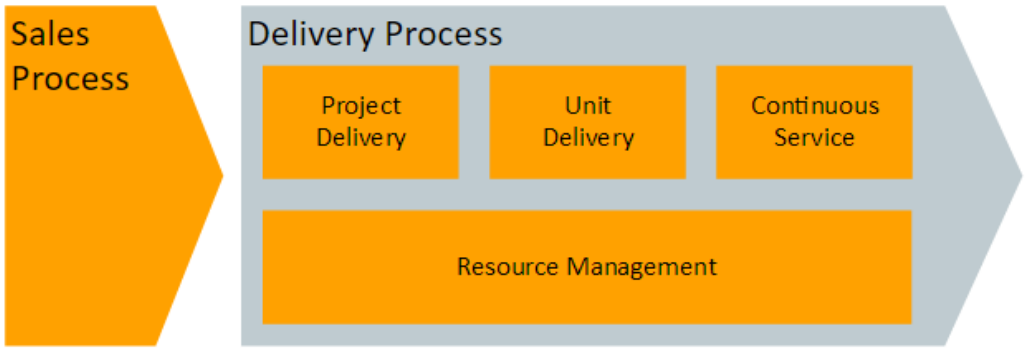

Figure 12. *Connection of Telecom Network division's sales and delivery processes.*

The purpose of the sales process is to handle the tasks all the way from recognizing the markets to closing deals and improving customer relationships. The sales process is a prerequisite for delivery processes and is the same regardless of the type of delivery.

There are three different delivery processes, which are separated based on the type of the delivery or contract made. Project delivery includes so called ABC-projects, which have a different steering procedures compared to unit deliveries or continuous services. In addition, ABC projects are larger in revenue and have a defined beginning and ending.

Unit deliveries consist of D-projects, tasks and time-based jobs. D-projects are smaller in size, simpler and less risky compared to ABC-projects. They are typically frame agreements and require more than one type of skills (e.g. designing, excavation, installation) to be performed. Tasks on the other hand are short and standard jobs that are based on a fixed price per activity. Typically, they require only one type of skills to carry out the job. Lastly, time-based jobs are more abstract and their work scope is difficult to define in advance. This is one of the reasons why these kind of jobs are invoiced based on hours. From unit delivery perspective, tasks and D-projects are the most common types of work, while time-based jobs are more of an exception from regular work.

Continuous services are usually based on multi-year service contracts and they mean that the case company as a service provider takes overall responsibility of a specific operational entity of the customer. An example of a continuous service offered by Telecom Network division is camera surveillance services. From the three different delivery process types, continuous services are the rarest ones.

Another business area that is crucial part of the delivery process is resource management. Resource management tasks such as resource planning and allocation naturally are related to all types of deliveries (as seen in previous Figure 12). Resource planning can utilize the information provided by sales process, as was also discussed in chapter 3.2. This information can be especially useful for long term resource planning and determination of long-term demand for services.

The sales process, different delivery processes and resource management process each have various activities and sub-processes. Sales process's activities include sales planning, customer contacting, tendering, contract hand-over and account development. Further, each of these activities have their own set of sub-processes. However, to keep it clear and concise, the sub-processes are not presented here in detail.

The three different delivery processes have very similar activities. Each of these processes have activities in four levels. First upper level activity is portfolio management, which has a task to handle a number of e.g. project delivery ABC-projects, unit delivery D-projects or continuous services. Next activity is customer process/delivery management, which includes sub-processes that are related to e.g. customer communication and co-

operation. The last two activities are connected to delivery/project management (e.g. planning and reporting) and delivery/project implementation (including the implementation/execution of the actual work on the field).

The resource management process is divided into three different activities/categories based on time span: long-term resource forecasting, mid-term resource planning and short term resource dispatching. Resource management process description and sub-process definition is one of the areas under development in the case company in 2016. The purpose is to define a group level resource management process and this process is implemented in every division. This resource management process is also highly interesting for this thesis and from the research questions point of view. Especially the mid-term term resource planning and effect on business unit resource management are discussed later in more detail.

4.2 Information systems in the case company

There are various IT systems that are used in the case company. These IT systems/software are the heart of the information systems. The interest in this thesis is to find out the relevant information that should be gathered from the different systems. The systems offer data and information that should be of interest for example for project stakeholders. On the other hand, these systems can also provide valuable information for resource management and logistics – which are another two interesting topics of this thesis.

Majority of the systems in use are closely connected to the delivery processes. Delivery processes also include the topics of interest – project/work management and resource management. Thus, the main focus is in the delivery processes and information systems connected to them.

Starting from the bottom in the IT infrastructure, the case company is using ERP as the base level platform that handles for example financial and human resource management (HRM) data. There is also operations planning system that is constructed on top of the ERP. That manages the various projects across the company. When work order is created based on customer's order, this operations planning system is the place where it drops first. Nowadays this system is not anymore the sole project management system in TN division. In the beginning of April 2016, another more evolved project management system was taken into use as a PMIS software. It does not replace the old operations planning system entirely right away, but is rather working besides it and taking project steering responsibilities in certain areas. The PMIS manages especially the D-projects related to telecom network construction business line. Later the purpose is to include also ABC-projects to this new PMIS software. ABC-projects are larger in size, but if they can be broken down into smaller pieces, they can be managed in the new PMIS the same way as smaller D-projects.

The PMIS comprises of several system modules that handle specific tasks. The case company has not yet taken every module into use. The purpose is to start with the most crucial ones and extend the usage later if necessary. “Core” is the main module, which handles individual projects. There for example production plan can be created, which defines the breakdown of work, resources used and revenue/cost estimation. Another module, “Gantt”, manages the schedule of individual projects. Every task related to the project is scheduled accurately, which results in visual timeline, where also critical path can be observed. The project responsible person plans, when each task is performed, which is then communicated for work performers and customers. When these tasks and work orders related to them are needed to dispatch to designers, field workers, subcontractors or documenters, “Plan” module is utilized. This module includes the individual workers, to whom the project related tasks can simply be dragged. Finally yet importantly is “Mobile” module, where the actual work is reported. “Mobile” is a web-based application, where the workers report following information:

- Which services/activities were performed
- Which materials were used
- How many hours did the performed tasks take (resource cost)
- Comments for activities performed
- Pictures taken related to the performed tasks

The performed amounts for activities, resources and materials are automatically moved to “Core”. In financial figures, the performed activities result in realized revenue and costs, which are compared to the production plan and income/cost estimate made earlier.

As presented in the introduction chapter, case company’s unit deliveries consist especially of D-projects and short-duration installation and fault repair tasks. Continuous services are also part of unit deliveries, but has a smaller significance compared to the other two type of deliveries. PMIS is used to handle D-projects, but tasks are managed with another task management system. The work orders are managed in the task management system and dispatched to field workers. This results in worker specific schedules, which is visualized in the system. The system enables the job control, but also the actual fieldwork reporting. Fieldworkers can read the work orders with their tablets or phones by signing in the system with a browser and also report the products used after the work has been completed.

Another delivery process and more specifically resource related system used is vehicle management information system. This whole system is based on vehicle tracking devices and vehicle reports provided by the case company’s system provider. The provider has installed vehicle tracking devices to majority of case company’s vehicles and these devices collect various data including e.g. vehicle speed, starting and ending times, office visits and idle times. This collected data is transmitted to the provider’s server and their

staff is responsible for analyzing the data and transforming it to clear and structure information in the form of a report. These reports should be utilized especially in the fieldwork management in business units. In addition, the reports provide valuable information regarding the field worker movement on the field. Based on for example driven kilometers or daily time used on a customer site can be for example some comparisons made between different months and deduced, whether the logistical changes have improved the field work operations or not.

Also business intelligence related web-based financial reporting tool is used to provide clear information of the financial performance levels of different business units. From the reporting system it is possible to print indicators regarding for example value of work and reliability of delivery. In addition, the reporting tool can also provide open work base lists and revenue accumulation information of the completed tasks.

4.3 Research strategy

Multiple qualitative research methods are used for the constructive research. According to Hall and Rist (1999), the use of multiple methods gives a more precise and accurate fix on the research question compared to any research method alone. Interviews can be arranged to gather individual opinions and comments, whereas workshops are excellent occasions to brainstorm solution alternatives in a group. This is why the multiple research methods are suitable for this research context, where a combination of individual and group efforts are needed. For example, a certain reporting related needs are based on individual preferences, whereas common requirements for business unit reporting are constructed as a group.

Firstly, information models are created for project monitoring and control purposes. The purpose is to look into monitoring and controlling of ABC-projects and D-projects; i.e. type of project deliveries. The most important questions asked in this context are: What information should different stakeholders (project engineer and business unit manager) collect/follow from projects and tasks? What are the customer (telecom network operator) information needs related to their work orders and work performed for them? What information regarding the work performed is important to collect in order to improve project/task control/monitoring and customer communication? What information is interesting regarding undergoing, completed and future projects and tasks?

In this first topic the goal is to create an information model for the two stakeholders of interest. The material for these models is collected especially through a workshop. In addition, two skype meetings are arranged to make further improvements to the information models.

The second topic concentrates on resource planning processes in the medium term. The discussion starts with case company’s group level processes determination in the short,

medium and long term. The purpose is to describe general resource management processes for all divisions. When the group level medium term resource planning process is in final form, it is then utilized to construct the medium term resource planning process for Telecom Networks. This process plan includes the needed sub-processes and detailed task descriptions, which guide the resource management in business units. Thus, the construction from this topic is going to be a resource planning process model. The material collection for detailed TN's resource planning process model is gathered from meetings arranged by the resource management team.

The third topic where a construction is involved is fieldwork management. Vehicle tracking system collects data from the case company's vehicles and creates also reports as described in the last chapter in the information systems section, but there is room for improvement in the reporting. This is why the goal is to create a better report (construction), which offers more benefits for fieldwork management. The reports are utilized especially by business unit managers, so the first step in developing the reports is to make interviews with a few BU managers and create a list of reporting needs. These needs then form a base for the requirements of the new report.

4.4 Material collection

This materials collection chapter focuses on describing the information model workshop's agenda in more detail. In addition, the group level resource management process is presented, which serves as a groundwork for TN medium-term resource planning process. Lastly, the vehicle tracking needs collection method is briefly described in the last sub-chapter.

4.4.1 Information model workshop

The information model workshop was held in Helsinki and three hours was reserved to the event. The original plan was that business line manager, development manager, human resource business partner, project office manager and financial controller would participate in the workshop. Due to schedule challenges, business line manager could not attend to this workshop in the end. However, with the remainder of the group we managed to create vivid discussions and create content and proper structure for the information models for BU manager and project engineer.

The agenda for the workshop was planned carefully. The purpose was to look into ABC-projects and D-projects, and the information related to these project types, which should be of interest to different interest groups. As revealed earlier, the chosen interest groups for these information models were business unit manager and project engineer. At first the idea was to include also project managers and portfolio managers as interest groups.

Also original thought was to observe also installation and maintenance task related information needs. However, it was agreed that it is wise to limit the area under observation to include only BU managers and project engineers, and ABC- and D-projects from project types. Installation and maintenance tasks are quite different compared to actual projects, and they are also managed in separate system, so the information needs and sources regarding tasks should be covered separately.

In the workshop especially important was to discuss about the target information or indicators that different interest groups should follow/be interested in regarding the ABC- and D-projects. For the workshop the author of this thesis sketched the information models, which would then assist guiding the discussion forward and also speed up the construction of the information models into the right direction. The original plan was to move forward by choosing first an interest group and project type. This plan realized quite well, although the discussion concentrated mainly on the business unit manager's information model. During the workshop, the sketched information model was updated in real-time. In addition, all the central comments were written to a memo.

4.4.2 Small group meetings on resource management

The case company has decided that there should be a group level resource management process, which means that all the divisions should follow the same kind of process. Of course there are differences in the actual tasks under the sub-processes, but the general lines should be same for all divisions. The resource management team (consisting of five people) gathered together to drive forward the group level process consists of five people including participants from Telecom Network, Power Network, Industry and Information Management division.

Resource management team has gathered together approximately once a month first to design the resource management group level process and then to follow the implementation of that process on division level. The resource management process is divided into three main processes: short-term resource dispatching, resource planning (medium term) and long term resource forecasting.

The resource management process was discussed in three resource management team meetings arranged through skype. Each meeting was scheduled for approximately 1,5 hours. In all of the meetings, four team members were present. The agenda for each meeting was approximately the same, including discussions on the resource planning processes on short, medium and long term. The focal point was on the sub-processes under each main process (short, medium and long): from which processes is e.g. short term constructed and what activities/tasks does it include? All the meetings were documented in a memo. The results of this work is presented in Figure 13.

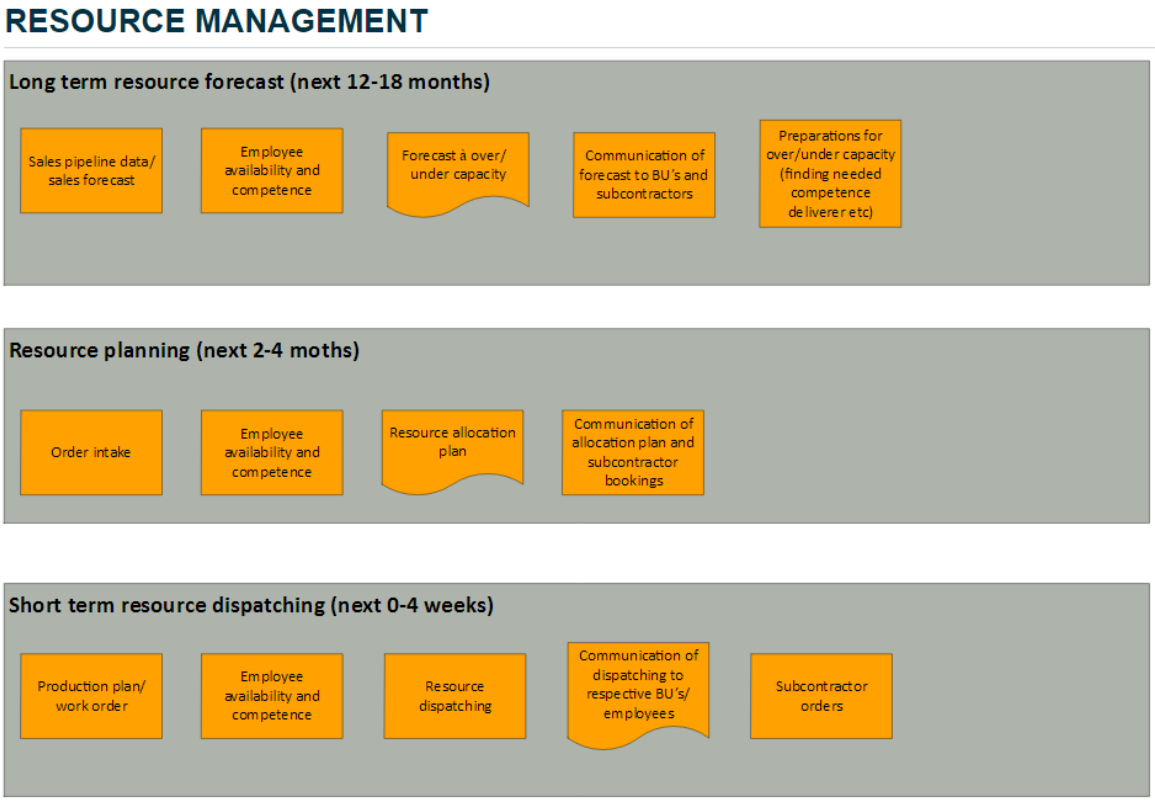

Figure 13. *Group level resource management process (common for all business divisions).*

This upper level process description was not core of this research, but it was rather a starting point and part of material collection for the medium term resource planning description from the Telecom Network division's point of view, which is the main target of this thesis related to resource management topic. In order to take the TN division perspective into consideration as well as possible, the resource management team discussion were analyzed and further discussed with development department's project manager.

4.4.3 Vehicle tracking reporting needs collection

Being a broad service provider on the telecom network construction and installation market, vehicle tracking is needed to keep track on the efficient movement of the field workers: the goal is to minimize travelling expenses and at the same time speed up the service lead time. The vehicle tracking system is used in construction business related work, as well as in installation and maintenance business. The general opinion is that the system is not yet utilized to its full potential, and on the other hand there is definitely room for improvement on the system side itself. So the goal in this research topic was to gather information for the tracking needs and create development targets.

Gathering of the vehicle tracking needs was carried out with interviews. In the end, a total of seven persons were interviewed: four business unit managers, a product group manager, a portfolio manager and a project engineer. Time reserved for each interview was

30 minutes. All the interviews were documented in a memo. The interview method used was a theme interview (qualitative method), which lies in the middle ground of structured and open interview: the area under discussion is defined, but the questions asked are not written down in great detail beforehand. Therefore, as the name of the method reveals, there is a specific topic or theme for the interview, but the progress of the interview is not precisely outlined beforehand.

In this research the theme for the interviews were "vehicle tracking system usage and development", so purpose was to find out how the system is used now and what are the development needs for the future. There were some key questions to guide the discussion:

1. How is vehicle tracking system utilized at the moment?
2. What are the needs for the tracking system and reporting, how should we utilize the system?
3. Are there challenges related to the tracking system?
4. What information is lacking on the reports?
5. Is there some information on the reports that is not needed?

Based on the answers it is then possible define e.g. what information is needed on the tracking reports and how could those reports be developed in order to serve the users more appropriately.

4.5 Data analysis

The analysis of the information model workshop results was based on the written memo and updated information model draft. The goal was to identify the important comments that were raised during the workshop and that got support from several participants. Examples of these were completely new information columns and new perspectives that should be included to the model. The author of this thesis further updated the draft of the model, which was then validated and refined in the following skype meetings.

The resource management related meetings material was analyzed especially from the medium term resource planning perspective. The relevant parts of the meeting discussion were divided into categories based on the medium term resource planning sub-processes: e.g. which part of the discussion was relevant from an "order intake" perspective? What needs to be taken into consideration when implementing the resource allocation plan? The meeting discussions and the information categorizations were also analyzed with the development departments project manager.

Vehicle tracking interview answers were categorized based on the key questions seen above. For example, the current tracking information usage and utilization was one category. If there was several similar answers related to same category/topic, those were prioritized higher than other answers.

5. RESULTS

This chapter starts with a presentation of the results from the information model workshop and skype meetings. The requirements for developing the information models are first presented before revealing the created models. Then this chapter continues with the resource management topic and reveals the results of those meetings, which were organized to determine group level resource planning process and further to propose for the Telecom Network business, what should be the medium term resource planning/management process for Telecom Network division in Finland. Lastly, also vehicle tracking reporting needs were identified, so this chapter presents the development actions regarding the vehicle tracking/fieldwork monitoring as well.

5.1 Requirements for developing the information models

There were useful observations right in the beginning of the information model workshop. The first idea raised was that the indicators or target information brainstormed should be connected to division level KPIs. Some of the central division level KPIs are listed below:

1. Revenue
2. EBITDA
3. Project Margin
4. Work Value
5. Revenue from new customers and/or products
6. Customer Feedback (NPS)
7. Delivery accuracy
8. LWIF (Lost Workday Injury Frequency) / Safety notes
9. Voice / Pulse Results

Revenue and Earnings Before Interest, Taxes, Depreciation and Amortization are quite self-explanatory and basic KPIs. Project Margin describes the gross profit of the projects. Work Value is calculated as

$$Work\ Value = \frac{Revenue - Material - Subcontracting}{Working\ Hours}. \quad (1)$$

Customer satisfaction in turn is measured with Net Promoter Score (NPS), which is calculated based on customer answers to a certain set of questions. The same kind of idea applies to internal Voice or Pulse results, where a survey is used to acquire feedback from personnel. Delivery accuracy describes, how well the company is able to stay in schedule and deliver the service to customer as is promised and written in contracts. Occupational safety is a high priority matter in the case company, so Lost Workday Injury Frequency

is an important indicator to monitor the development of the safety at work. There has been an observation that the more there are safety notes made, the less there are accidents and lost workdays. Thus, a goal for the creation of safety notes has been made for the Telecom Network division in Finland and the results are monitored weekly.

When connecting the indicators to upper level KPIs, it assists the target interest groups to understand the broad division level effect of monitoring the indicators and managing the projects or performed work based on the results that the indicators give. Linking division level KPIs to BU level indicators has benefits also from division's point of view. If division level KPIs are showing concerning values, then the interest shifts to the reasons behind the values. In order to get the handle of the reasons, analyzation of BU level indicators is needed, because naturally business units' operational performance forms the performance levels of the entire division.

Swedish telecom network division had already brainstormed a list of KPIs that should be monitored related to projects. The data related to those KPIs is gathered from the project management system and printed in a report form with the reporting software tool. Another great idea in the information model workshop was to utilize the work already done in Sweden and pick the relevant indicators from the Swedish list that should be monitored also in Finnish ABC- and D-projects. The indicators do not need to be exactly the same, but can be modified slightly to be better suited for performance goals of the Finnish business. The main interest group that should be interested in these indicators and should monitor them and report forward are the business unit managers. The relevant measures taken from the Swedish indicator list are presented in Table 4.

Table 4. *List of project related indicators brainstormed in Sweden that should be monitored also in Finnish telecom network projects.*

Measure / indicator	Definition
Project margin (%)	(Booked revenue - booked cost) / Book revenue per project
Work in progress (WIP) per project	Reported revenue (not booked yet) for jobs
Orderstock value	Order value - booked value - WIP
Planned vs. actual project revenue & cost	Calculated vs. booked revenue & cost accuracy
Lead time	The time gap between specified job statuses, e.g. lead time from "technically ready" to "invoiced"

Measure / indicator	Definition
Delivery precision	Comparison of the actual delivery date and contractual requirements
Project plan time deviations	Deviation between planned and actual statuses of a job
Total business volume, turnover	Value of all finished projects during period per BU
Turnover per planning technician	Value of all finished projects during period per planning technician
Projects per status	Amount of jobs per milestone statuses
New jobs received	Weekly received new jobs plus trend factor
Revenue forecast	Monthly/weekly calculated revenue per project/work responsible or BU

Towards the end of the workshop it was also highlighted that there should be a mark for each measure including a possibility that it might require specific actions (from the business unit manager or project engineer) already during the progress of a project, if the measure indicates that something should be done. For example, if WIP is high, then planning engineers or managers need to make efforts to speed up the work performed on the field, which might require acquiring more resources, i.e. workforce.

In addition to the workshop held, there was also two separate skype meetings related to this information model construction topic. After the workshop, there was already two separate information models drafted from BU manager and planning engineer perspective. These drafts were then presented in the skype meetings. The first meeting was held with the development manager and human resource business partner. This meeting brought up one crucial requirement to the information models: the pieces of information that should be followed and reported forward should be divided into reporting periods, meaning that some indicators should be reported weekly, while for other indicators monthly reporting is sufficient.

In the second skype meeting the information models were presented for the business line manager (who could not attend the initial workshop) and for a development engineer (who is managing the new project management system project). This discussion concentrated

mainly on the information sources that should be included in the models. It was highlighted that the information sources can be different for BU managers and planning engineers. BU managers require a clear report of performance indicators, whereas planning engineers can utilize the available information directly in the project management system. Reporting tools are needed to create the performance indicator reports. During the meeting it was suggested that in order to follow the important indicators comprehensively, two separate reporting tools should be used to satisfy the reporting needs.

5.2 Created information models

The final versions of the information models were constructed based on the ideas and feedback given in the workshop and skype meetings. As stated earlier, the information models were created for business unit managers and planning engineers, related to ABC- and D-projects. In the end, it was decided that both ABC- and D-projects could be included in the same information model. This is possible, because the actual information needs are quite similar in smaller and bigger projects. There might be minor differences in cash flow monitoring, which is more detailed in larger projects. Overall, the general opinion was that for example the revenue/cost, schedule and quality need to be monitored extensively and accurately regardless of the project type.

The refined information models for BU managers and planning engineers are presented in Appendixes A and B. Both models are constructed the same way and include same information columns. If we look at the structure of the model systematically, it starts with measurement category, which includes seven different options (not in priority order):

- Finance
- Schedule
- Quality
- Productivity / Efficiency
- Resourcing
- Work safety
- Communication

These are the central categories, which then include the actual measures/KPI's that are important to follow. If we compare this list to the construction projects related KPI's compiled by Yun et al. (2016), similarities can be noticed. All researches listed by Yun et al. recognized cost, schedule and quality performance to be key indicators that need to be measured in construction projects. In addition, safety performance was relevant in many researches, which is another central connection to this research at hand. Occupational safety has high importance in the case company, so it was raised as one central measurement category.

Productivity and communication are also KPI categories that can be found from few researches, where they are seen as important areas to measure in construction projects. In the case company and in the information model workshop these areas were also seen very important. One area which differs from the research collection done by Yun et al. and the most common KPI categories is resource management. Having said that, it naturally depends on interpretation, whether resource management related measures here in this research (e.g. work value and capacity utilization rate) could be also seen as productivity measures.

The second category of the information model is work type, so in this case it can be ABC-projects or D-projects. The actual KPI or measure of interest is related either to ABC- or D-projects, or in most cases both. Speaking of the measurements of interest, these construct the third category of the information model. These KPIs are naturally the most important and interesting information in this model. They are measures that are seen as important to follow in Telecom Network business. As we can see from the model for BU managers, there are 29 important measures recognized. That number reveals that there are too many measures that can actually be identified as Key Performance Indicators. As Chan and Chan (2004, p. 209) mention, Key Performance Indicators need to manageable, which means that they need to be limited. They also add that if there are too many KPIs, it results in excess consumption of resources and time. Because the information model of this research includes so many indicators, they cannot be all identified as KPIs. Rather, these measures construct a comprehensive set of indicators, where some of them are more important (and can be seen as KPIs), but some are more ad-hoc type of measures that can be followed situationally.

The next two categories/columns in the model were added based on the successful brainstorming made in the workshop: connection to the division level KPIs and an indicator presenting whether the observed measure could result in actions during the execution of the project or job. These pieces of information facilitate to understand the connection of the measurement indicator to upper level goals and important indicators, as well as indicate whether the results of the measure require fast actions even during the implementation of the project or individual order/job.

“Source” category presents the location, where the information for the specific measure/indicator can be found. In practice, this location could mean the actual reporting tool and a specific report that is used to present the delivery process related information. The source could also be the project management system, i.e. the initial source for the information, especially for planning engineers who use the system on daily basis.

Reporting targets and reporting frequency are presented in the last categories of the information model. This is crucial information and reveals, how often the measures are reported and to whom or where. For Finnish Telecom Network business, weekly Telecom network’s production meetings are important occasions, where for example some of the

indicators brought up in this model could be reported for the managing director. The model divides, which indicators could or should be reported weekly and monthly. However, improved BU reporting to the upper level is only one minor goal. The business performance and especially project/work management development based on the results that the important indicators give, is the crucial area where improvement and benefits are pursued.

5.3 TN medium term resource planning process

The purpose here is to look into the medium term resource planning process and identify the tasks under the sub-processes (see Figure 13 on page 50 and resource planning process). In addition, the focus is targeted especially to the Construction business resource management, because in that business the medium term resource planning is more relevant than in Installation and Maintenance business (which includes mainly short term fast paced tasks). Information management, which is the main topic of this research, has a crucial connection to the resource management as well. It is important to distinguish the importance of information systems in medium term resource planning: how the project management system is utilized, when for example order book is needed to be determined (demand side). On the other hand, naturally the supply side has to be matched with the demand, which requires comprehensive and accurate information of the current employee capabilities and availability.

The group level medium term resource planning process and its time period is open to interpretation: sub-process description identifies that medium term time period is 2-4 months, but this is not necessarily the case for every division. For example, for Telecom Network division the resource planning time period for network construction jobs is closer to ~2weeks – 2 months. This is the reason why on group level it is not possible to lock the time periods into certain values, so in this case the time period should not be interpreted literally.

However, the sub-processes itself are accurate and applicable for every division. The common processes for each division was a main goal for the case company, and this was achieved in the resource management team meetings. Each of the sub-processes have a general level goal/meaning, but the included tasks to achieve this purpose may vary across divisions. For the TN medium term resource planning process, these tasks were created based on the discussions in the resource management team meetings. The discussions were analyzed from TN perspective with the development department's project manager. Some of the tasks were modified to be TN specific. For example, at the moment only TN is utilizing the new PMIS to manage and monitor customer orders. The medium term resource planning sub-processes and respective tasks are presented below from Telecom Network's perspective (Figure 14).

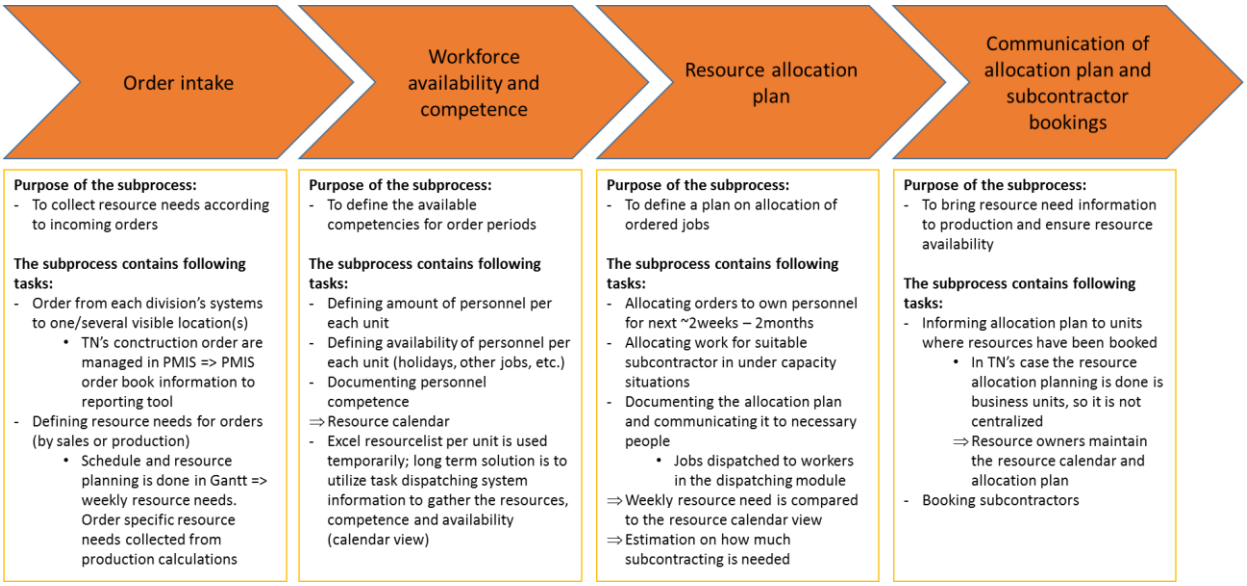

Figure 14. *Medium term resource planning process (Telecom Network construction business perspective).*

Order intake sub-process includes the utilization of the project management information system. The orders are accepted and planned in the system, and the resulted information of the open jobs can be exported to the reporting tool. When the orders are planned in "Gantt", the weekly resource needs become visible for order book. However, this information from Gantt is not order specific, so it is needed to fetch the production calculation information (actual planned activities/products and resources for them) in order to find out the resource need per order.

The second step is to keep track of the availability and competencies of the workforce. This requires a timely list of resources per unit, skills of those resources and availability information (calendar view). In the resource management team meetings it was highlighted that the current HRM system has correct competence related information, but the challenge is how to keep this information up-to-date and integrate it to project management system. Ideal tool for handling all the resource related information would be the dispatching module, where a calendar view for each resource with availability and skills information would be in use. Thus, the long-term plan is to dispatch the construction business jobs in a suitable module (currently used in task dispatching) that has the technical solutions to support the resource management. However, this was discussed with the development department's project manager and the integration to support this functionality will not yet be built during the first half of 2017.

When order stock and workforce availabilities on the medium term are visible, the next step is to allocate the resources to the orders. The current dispatching tool for network construction projects/orders is a module called "Plan". From Telecom Network's perspective, the dispatching module is the location where allocation is monitored, so there is no need for separate documentation of the allocation plan. When looking at the general

view of the order allocation on medium term, it would be useful to compare the weekly resource requirements for the planned jobs (made in “Gantt”) with the availability of the appropriate workforce. This way it is possible to evaluate the need for subcontracting and also keep the capacity level of own resources at an optimal level.

Lastly, the allocation plan needs to be communicated to the field workers (including also subcontractors). In Telecom Network’s case, production makes the resource allocation to orders, so there is no centralized resource allocation unit. When the resources are allocated to the orders with the dispatching tool, the orders are then visible for the field workers in the work reporting module. There the workers can see all the work orders dispatched to them and when those orders should be delivered to the customer. In addition to the software, the resource allocations can also be communicated to the workers with more traditional ways including e.g. email and phone. However, the main communication tool is the information system consisting of the project management system modules.

5.4 Vehicle tracking information needs

The vehicle tracking system creates and sends timely reports of the case company’s vehicles. There are master reports, business unit reports and dimension (inside a specific BU, for example Installation and Maintenance vehicles) specific reports. Each of the reports include the same set of measurement indicators:

1. Length of the day (beginning vs. ending, total working time)
2. Time used on the work area
3. Driving time
4. Time used at the office
5. The amount of office visits
6. Directly to the office when starting the workday?
7. Idle time
8. Travel distance (kilometers)
9. Max. speed
10. Average speed
11. Starting time (of the day)
12. Ending time (of the day)

The difference between the reports is then only in the target vehicle groups, i.e. which vehicles are taken into account on the report. These indicators are measured daily and are visible in the reports that are distributed to e.g. business line and business unit managers weekly.

Based on the answers collected in the interviews, tracking data is used specially to reveal the flaws in the field operations. The data can reveal for example abnormal driving times or time used on the work area. Furthermore, the data available opens the possibility to react to the abnormal events. The goal is to find out the problems and create corrective measures. When the tracking system was taken into use, there was great interest especially in the amounts of office visits, total working time, time used on the work area, driving time and whether the workers start the day by going at the office or directly to the customer work area.

Vehicle tracking information is useful also for the fast-paced maintenance needs. Faults are solved faster, when there is tracking information of the closest vehicles. Further, faster maintenance services mean more satisfied customers and more satisfied customers mean closer customer relationship and stable or growing order book.

At the time the interviews were arranged, the needs for the tracking system were quite clear. Of course the business managers and field managers are especially interested in the reports created through the system, so for them it is very important that the reports are clear and unambiguous. The visual appearance of the reports has a significant meaning: the report needs to be comfortable to ready and the important data should be easily spotted "with a glance". The reports did not indicate visually, where the manager should direct his focus. Business unit managers are very busy with running all the common daily tasks and dealing with unexpected issues, so they need information in "ready to use" form. In other words, they need information that is processed from raw vehicle tracking data.

In addition to the tracking of the vehicles and following the central indicators, the need for the system includes also cost management and work safety related matters. Even in the beginning when the tracking system was taken into use (in 2014), it was outlined that the system would be utilized in tracking the travelling costs (driver's log) and that the costs per kilometer would be then directly assigned to the respective job or project (tracking system integrated with the project management system). That functionality or integration has not been implemented, but the same need applies to this day. From work safety development perspective, "lone working" functionality would be a welcome feature in the system. In practice, this means that there would be some kind of button or trigger in the vehicles, which the technician needs to press or select when starting the job. This message is then directed to the job control. If the technician does not end the job within a certain time (push the trigger again at the end of the work), an alarm message is sent to the job control.

There are also challenges with the tracking system and utilizing the tracking data. When the system was taken into use, there was a lot of controversy whether tracking is acceptable. However, the point is to track the vehicles, not the people. The most important goal is to ensure the efficient movement of the vehicles (maximize time on the work area and minimize the driving time) and improve the maintenance lead times (track the closest

vehicles of the fault locations). Nowadays there is better understanding on the field about the system and conflicting opinions have reduced. Another practical challenge in the utilization of tracking data is the nature of the network construction jobs: the work is often lengthy and different compared to installation and maintenance tasks. There is a lot of material and document collection at the office, so it is challenging to reduce the amount of office visits, even though the tracking data might reveal higher numbers of visits compared to the goal. The appropriate way to reduce the office visits is to change the delivery process and communication between job control and fieldworkers (transmission from papers to electronic communication). In addition, material handling and warehouse management need new processes and further utilization of logistical partners.

Another perspective is the quality of the tracking data. The manager sees the measurement indicator and the result it gives, but the actual calculations behind those measures are unknown. This is why it is sometimes hard to trust the results that the indicators give. Naturally, system provider's responsibility is to ensure high-quality data, which describes accurately those indicators that are measured.

Lastly, there were also discussion about the measures itself, whether there are some indicators that the managers would like to see or on the other hand, if there are some measures that are not followed at all. Overall, most of the indicators were seen important and that they should be followed regularly. Although travel distance and average speed were not raised specifically interesting in the discussions. The managers did not really have additional ideas for indicators outside of the existing list. Sometimes there are problems with the tracking devices and the connectivity of those devices, so one idea was to start tracking the data transmission frequency: if a device did not send any data within a certain period of time, these vehicles should be visible on the week report.

5.5 Vehicle tracking report development

Based on the discussions arranged with the BU managers, the next step was to write down development ideas related to the tracking system. This brainstorming resulted in a central development item, which included the visual development of the tracking system reports. Better visualization improves the readability of the reports and assists in finding the most important data. The description of the development need comes from the case company, whereas the technical development is done by the system provider.

The original vehicle tracking data from the weekly reports is presented in Table 5. The actual data is replaced with sample data. As the table reveals, not only it is challenging to spot the pieces of data that should be noticed, it is also difficult to compare the performance of different vehicles. The original report was constructed in a way that it shows all the indicators under a specific vehicle.

Table 5. *Original vehicle specific tracking report (sample data).*

Vehicle: AAA-109
Working days: 5

	Average	21-11-2016	22-11-2016	23-11-2016	24-11-2016	25-11-2016	26-11-2016	27-11-2016
Length of the day (beginning vs. ending)	11:02	08:44	08:35	09:00	14:43	14:07	00:00	00:00
Time used on the work area	08:40	06:52	07:14	06:16	11:49	11:10	00:00	00:00
Driving time	02:09	01:45	01:20	02:43	02:15	02:42	00:00	00:00
Time used at the office	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
The amount of office visits	0	0	0	0	0	0	0	0
Directly to the office when starting the work day?	0	0	0	0	0	0	0	0
Idle time	00:16	00:00	00:05	00:00	00:28	00:00	00:00	00:00
Travel distance (kilometers)	102,9	89,38	68,37	145,41	108,71	102,62		
Max. Speed (km/h)		105	93	106	94	86	0	0
Average speed (km/h)	36,78	36,11	42,15	43,93	38,21	32,51	0	0
Starting time (of the day)	05:57	07:03	07:07	06:52	06:52	01:48		
Ending time (of the day)	16:59	15:48	15:42	15:53	21:36	15:55		

Thus, the report related needs communicated to the system provider consisted of visual improvements and reconstruction of the report so that all the vehicles of the dimension would be visible under each indicator. The communication was done through a couple of meetings with the representative of the provider. Related to the visual improvements, the idea was to bring "traffic lights" effect to the weekly reports. The traffic lights indicate visually, where the manager should focus when reading the report. Measurement indicators, which are within accepted boundaries, are marked as green, whereas indicators outside of the boundaries are red. A draft report (one measurement indicator shown) including the improvement is presented in Table 6.

Table 6. *Visual improvements to vehicle tracking report (sample data).*

Time used on the work area	15-08-2016	16-08-2016	17-08-2016	18-08-2016	19-08-2016	20-08-2016	21-08-2016
Cost center 99999_1							
AXX-111	05:05:00	06:55:00	07:12:00	00:00:00	08:20:00	00:00:00	00:00:00
EEE-222	03:03:00	07:50:00	06:30:00	06:37:00	05:51:00	00:00:00	00:00:00
IJJ-333	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00
LNN-444	05:18:00	05:02:00	05:07:00	05:04:00	04:18:00	00:00:00	00:00:00
MNN-555	01:41:00	06:44:00	07:41:00	06:26:00	08:27:00	00:00:00	00:00:00
SKK-666	05:47:00	05:57:00	05:46:00	06:30:00	07:09:00	09:01:00	00:00:00
XUU-777	06:19:00	06:55:00	06:49:00	06:18:00	05:23:00	00:00:00	00:00:00
XVV-888	02:36:00	05:27:00	11:34:00	15:32:00	06:51:00	00:00:00	00:00:00
Grand Total	**05:49:00**	**20:50:00**	**02:39:00**	**22:27:00**	**22:19:00**	**09:01:00**	**00:00:00**

For "time used on the work area", values within boundaries are between 5-10h (green). The report being in this form, it is easier to compare the performance of vehicles. Also naturally it is easier to spot the deviations (values outside of the boundaries). Managers are able to detect the problem areas faster, and act accordingly. Their time usage regarding vehicle tracking is expected to be more efficient with the new reports.

5.6 Updated framework on the use of delivery process information in developing business performance

The tentative framework for this research was presented in chapter 3.4. Now the empirical results achieved in this research can be connected to that framework (Figure 15).

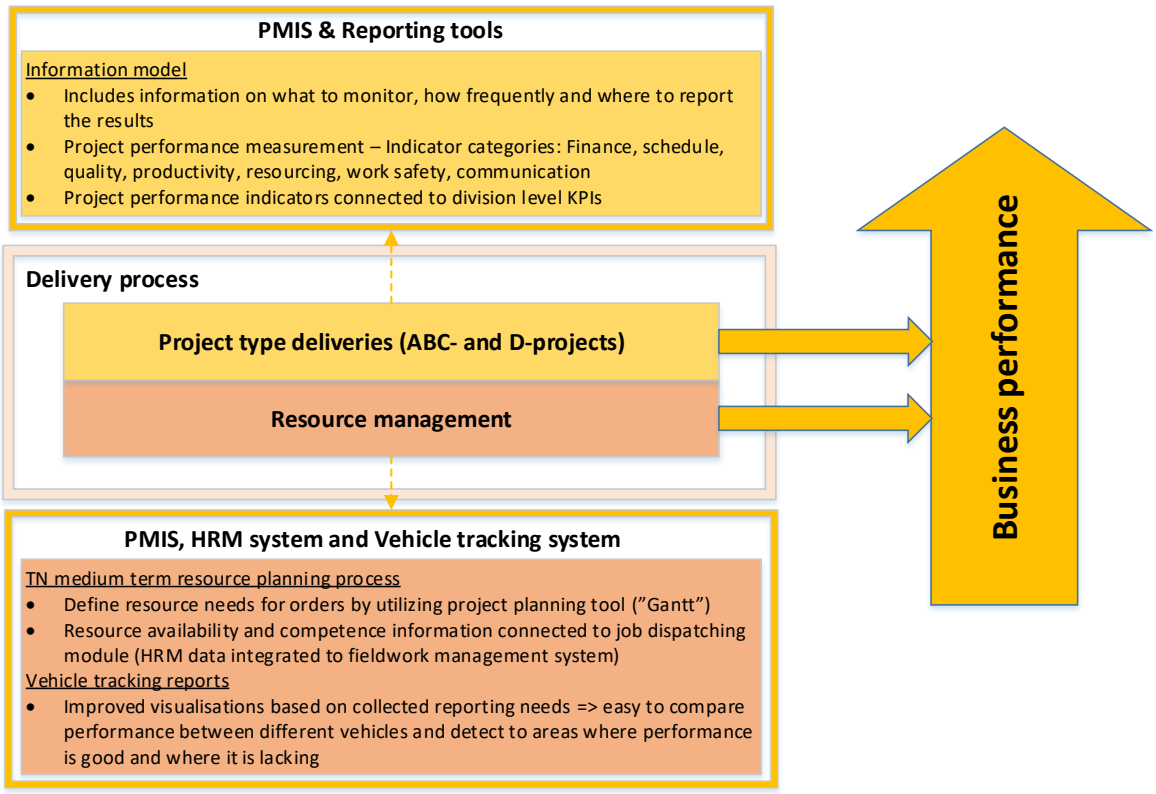

Figure 15. *Updated framework on the delivery process information usage to improve business performance.*

The created information model is connected to the project type deliveries process (includes ABC- and D-projects from the case company perspective). The important performance indicators were identified that business unit managers and project engineers should monitor. Work safety, cost, schedule and quality related indicators are valued very high in the case company, which is a similar result than Yun et al. (2016) found in their research about key performance indicators used in construction project business.

In the resource management area, TN medium-term resource management process was presented. From IS perspective, PMIS and HRM system have a central role in this process, because these information systems are utilized when forecasting future demands for services and making the workforce skills and availabilities visible. The case company does use simple quantitative forecasting methods to determine the future demand for their services. Historical data is used as a base value and current business goals are taken into

account when monthly budgets are created. However, when business units evaluate the demand for their services, it is mainly based on judgments and historical experiences. Thus, there is a lot of work to be done in the case company to improve demand forecasting on medium term. The proper first step is to start utilizing PMIS information and plan the implementation of customer orders to evaluate the resource needs.

Another resource management related result was the resolved needs for vehicle tracking reporting and actual improvements made to those reports. These improvements are expected to have positive impacts on vehicle performance monitoring. In chapter 3.3 the vehicle tracking benefits for logistics optimization was briefly presented, and that is an area where the case company needs to focus next from vehicle tracking perspective. The incoming job assignments should be included in the vehicle tracking system, so that the system could propose driving routes for the technician.

6. DISCUSSION

This discussion section focuses on bringing forward the practical benefits and impacts of the results achieved in this research. In addition, the empirical results are reflected to the theoretical background.

The analysis starts with the discussion on the information model and how it is utilized in telecom network business. The second topic covers the evaluation of the impacts of the new resource planning process (medium term). Finally, vehicle tracking report development improves fieldwork management and serves as a reference point for future vehicle reporting development steps, so those impacts are also discussed and reflected to earlier research.

6.1 Information model usage in the organization

The created information models for business unit managers and planning technicians enable benefits from several perspectives. First of all, upper management needs for business reporting were revealed in this research. Now it is clearer for upper management, which indicators are important to follow and what information they need from business units in order to create a clear picture of the success of those units. In addition, the information model that was created and the KPIs that were listed are also important indicators in Swedish business divisions. This improves the central goal to unify the ways of doing business, not only between business units inside a single division, but also between divisions and countries. When division measure their project success in the same way, the performance comparison of divisions is much easier.

Second perspective where the information model provides benefits is the BU managers' unit management, leadership and reporting responsibilities. Every business unit have for example certain financial and work safety related business goals. When indicators are created to a report form and brought visible with the help of information models such as the one created in this research, managers have better tools and instructions to follow the indicators and perform corrective measures in order to reach the business goals. BU managers also have weekly and monthly reporting responsibilities and the information model created in this research supports these responsibilities very well. Managers are able to see the indicators they need to follow, where they can receive the needed information, and when or how often this information should be reported further. So from manager perspective it becomes clearer, what are the needs for their reporting and how does that affect to the division level reporting (indicators are connected to division level KPIs in the information model).

Going one-step further, planning engineers could also benefit from the information model. In the same way as the reporting demands became clear for the business unit managers, the planning technicians' information model provides the indicators that should be followed (goals become more visible) and reported further. Compared to BU managers' information model, planning engineers have less monitoring and reporting responsibilities especially in work safety, resourcing and quality related indicator categories. BU managers are the resources "owners" and they have the main business monitoring and reporting responsibilities, so it is logical that they have more performance indicators to follow.

Planning engineers have the main responsibility in using the newly adopted project management system implemented in the telecom network construction business. The results from the information model's indicators are based on the information that is put to the project management system. Therefore, if planning engineers follow these indicators and their results closely, they can connect the relationship between their system usage and project performance: if the indicators are showing extraordinary figures, there might be a lack of information in the system. In addition, when projects are followed in more detail with several measures, that should have an effect on project management and productivity. For example, when project profit margins are followed, it is necessary that all the project revenue and costs are booked to the correct project and jobs. Without indicators/measures there would be more freedom to diverge from correct processes and manage projects in one's own way.

One of the largest direct benefits overall from the information model is for the reporting development. For the business report creating process, these kinds of information models are excellent ways to communicate the reporting needs of telecom network business to the system reporting experts. The report creation is an ongoing process and so far the effort has been put to especially develop customer reporting, financial forecasting (forecasted invoicing and revenue/cost for the ongoing month) and project management system compliance monitoring. All of these crucial areas and their measures are also listed in the information model. Important process indicators such as lead-time and jobs' budgeted revenues by job status are currently build and presented from another reporting system. However, the long-term goal is to retrieve the business reports from a single reporting system.

This research's created information model is heavily connected to the information that is gathered from the new project management system. The results of this research reflect very well to the theory presented in the first chapters and especially to the information system benefits listed by Nickerson (2001). The biggest unity is that the case company is able to produce a significant amount more essential information with the help of the project management system. There is more information available in systems and thus there are more perspectives to analyze the success of projects. Decision support benefits of ISs

is an important factor also mentioned by Gurbaxani & Whang (1991). However, as Skyrius et al. (2013) revealed with their decision support system cycle, making a decision requires always the usage of the user's experiences while IS being a supporting tool.

Nickerson (2001) stated also the importance of IS in documentation and communication. When all the relevant information is gathered to the system, it is always available there, i.e. the information is documented. Tacit knowledge is kept to a minimum, so that the information is not only in the hands of a project manager, but also available to upper level business line managers. A crucial perspective in the system usage is also the fact that it drives the processes of different business units in the same way – unified ways of making business. This is a very important goal for the case company, and the newly adopted project management system also aims to support in reaching this goal.

Delone and Mclean (2003, p.24) brought out the important relationship with system usage and net benefits of the IS. During this research it became very visible that the system quality affects greatly to the user satisfaction and intension to use the system (see Delone's and Mclean's IS success model on p. 18). If users are not satisfied with certain functionalities in the system (e.g. adding job related comments in a project management system is complex or time consuming), it affects negatively to the system usage and instead drives users to find out alternative solutions, which replace the system usage. These alternative solutions are unfortunately degrading the quality of the information in the system, which ultimately results in lower net benefits from the IS. If the information put to the system is lacking, project managers are collecting the needed information from elsewhere. This strongly supports Ali and Money's (2005) and Raymond and Bergeron's (2008) studies, where a high correlation between the perceived PMIS information quality and the use of PM software was found. When the project management system was taken into use in the case company, it was clear from the beginning that change management plays a significant role in the implementation. If the change management fails, the system usage is lacking and the quality of information gathered from the system is poor, making the indicators and business reports incomplete. For this purpose, compliance monitoring related to system usage was set to high priority right from the beginning. As stated earlier, one of the first reports created related to the newly adopted system, was the compliance report.

Performance measurement cycle presented by Morris and Pinto (2010, p.78) fits also well to the results achieved with the information models so far and how the case company is constructing KPIs. As discussed earlier, the information models act as a basis for the indicator report development in the reporting tool. Therefore, the models tackle well the early performance measurement cycle phase – what to measure? The reporting tool itself and the utilization of information system's database solves the question "how to measure?". In the third phase a comparison of actual performance and a standard (target) is

needed. In the case company, the target values for actual performance numbers need to be clarified and linked to the division level KPI target values.

6.2 Information model validation

The information model for business unit managers was chosen as a target for the validation, because the project management information system utilization and key performance indicator evaluation was seen as the most important topic in the case company.

The validation of the information model was constructed through a survey. The "information model for business unit managers" was sent to nine business unit managers, and in the end six of them managed to answer to the survey. The survey included a simple question:

How big of an impact the indicator/measure has from business unit project management and business unit leadership perspective?

In other words, how important the specific measure is for project management and business unit work or personnel management? Each indicator is evaluated with a certain number. The alternatives for scoring are the following:

1. No impact
2. Little impact
4. Quite important
5. Very important

The possibility to mark the indicator with a value three was excluded to avoid the "middle ground" answers. The results of this survey is shown in Table 7. The table includes the indicator and the average score based on the answers.

Table 7. *Survey results.*

Category	Indicator	Score (average)	Stdev.
Finance	Actual vs. Budgeted revenue & cost during the period (mo)	4,5	0,5
Finance	Actual vs. Budgeted profit margin (mo)	4,5	0,5
Finance	Work in Progress	3,0	1,4
Finance	Order book value	4,2	0,4
Finance	Scheduled payments for jobs with order value over 10 000€	3,3	0,9
Finance	Actual vs. Forecasted invoicing for the period (ongoing month)	4,2	0,4

Category	Indicator	Score (average)	Stdev.
Finance	Forecasted budgeted revenue and cost for the period (ongoing month)	3,8	1,3
Schedule	Job milestones actual vs. planned schedule	2,2	0,9
Quality	Job lead time	2,5	1,1
Quality	Delivery reliability	4,2	0,4
Quality	Reclamations	3,8	1,3
Quality	PMIS compliance	3,3	0,9
Quality	Bottle necks: Job amount per status/milestone	2,7	0,9
Quality	Change management in projects, e.g. cost and schedule changes	3,2	1,2
Productivity	Delivered jobs during the period (mo)	3,3	1,4
Productivity	Delivered jobs and their booked revenue during the period (mo) per job responsible	3,0	1,4
Productivity	Field work productivity indicators, e.g. time used on the work area vs. lenght of the work day	3,5	1,5
Resourcing	Short time period: Resource requirements for planned jobs	4,0	1,0
Resourcing	Medium term resource need evaluation based on technical planning of jobs	2,8	1,2
Resourcing	Long term resource need evaluation by work type	3,5	1,1
Resourcing	Work value: portfolio and work type based value Formula: (Revenue - Materials - Subcontracting) / Booked hours	4,2	1,1
Resourcing	Capacity utilization rate: Formula: Booked hours for jobs / Work hours in total	3,2	0,9
Resourcing	New confirmed jobs in PMIS by week	3,3	0,9
Work safety	Occupational accident / Safety notes	4,2	0,4
Work safety	LWIF (Lost Workday Injury Frequency)	3,7	0,7
Communication	Customer feedback	4,0	1,0
Communication	Feedback from White-collar workers / Field workers	4,2	0,4
Communication	Communication from upper management: Business goals etc.	3,3	0,9
Communication	Risk management: detected risks and corrective actions	3,0	1,0

The results show that there were exactly 10 indicators that got an average score 4,0 or above, which means that these indicators have importance in project and business unit

management.. According to the business unit managers, the most important indicators for project and business unit management are the two financial measures:

- Actual vs. Budgeted revenue & cost during the period (mo)
- Actual vs. Budgeted profit margin (mo)

The lowest scores were marked for “planned vs. actual job milestones” and “job lead time”. This indicates that these schedule related measures are not as important for BU managers as financial, work safety or communicational indicators. The results also show that quality related indicators (with the exception of delivery reliability and amount of reclamations) received even surprisingly low scores.

These are interesting results that show the preferences or values of business unit managers. The financial indicators will always remain high in priority, because those are the key performance indicators that are usually used to evaluate the performance of a business unit. Work safety related measures are seen important as well partly because of the fact that this has been an important topic on the group level of the company.

6.3 Medium term resource planning process impact

The medium term resource planning process model (related to TN construction business, see page 58) has the characteristics that can significantly improve the resource planning of business units. The key is to make the resource requirements, know-how and allocation visible through the information systems usage. From construction business perspective, the planning of projects and jobs have an extremely important role. The job or project should be divided into several specifications or work orders and these individual pieces should be scheduled in “Gantt”. When every specification has certain resources behind them to perform the task, and the specification is scheduled, we have the resource needs for certain time period forecasted. In the next phase, the competencies of the personnel should be kept up to date in the specification dispatching module – meaning “Plan” or task management system. The availability and competence need to be visible in the system so that the process of dispatching a certain job for a technician could be possibly automated in the future. This is also one of the central impacts that this process model should eventually achieve – increase the automation of job/task dispatching to the resource.

Subcontracting constructs a large part of the cost structure in the case company’s business, so it is a very important aspect to consider in the resource planning process as well. The subcontractors naturally cannot have the same kind of access to the information systems as own personnel. This is why a separate work order reporting module was constructed for the subcontractors. There they can retrieve all the jobs dispatched to them and report the work actuals. However, currently there is missing the “notification” functionality, meaning that there is not an automated message (e.g. email notification) to signal

that now you have this job in your “queue”. This message need to be manually sent to the subcontractor at the moment.

From project management system perspective the right pieces are there, which will improve also the resource management. “Gantt” is used to plan the resource requirements, “Plan” and task management system are used to match the requirements and resources, and reporting modules such as “Mobile” (together with notification functionalities) is the way to notify the resource that this specific job should be performed. The implementation of the resource planning process is still very much in early phase. “Gantt” usage is minimal at the moment and it requires much effort to put this to practice in every TN FIN business unit. Also the functionalities in “Gantt” need to be developed further. For example, the initial resource plan for the job made in “Core” should be directly visible in “Gantt” also. At the moment that is not the case. Then, another big task would be to figure out, how the planning made in “Gantt” is visualized on the work order that is going to be dispatched. The key information would include how long is the job planned for and for which resource type. Together with basic job information (name, type etc.) these work orders could then easily be assigned to a resource in the dispatching module.

Planning and scheduling of jobs takes a lot of time, which means that the actual resources requirements might become visible rather late. This is why it would be useful to utilize forecasting methods that for example are connected to historical data. When “Gantt” is fully implemented to cover the planning of ABC- and D-projects, it is beneficial to store the monthly or weekly data related to resource needs. Then when data from several months is collected and stored, it becomes possible to use e.g. simple moving average forecasting techniques with trend factor applied to forecast for example network technician needs for the upcoming weeks or even months. As Pilinkiené (2008) implies, seasonal fluctuations need to be taken into consideration (which is significant factor in case company’s business) and for that purpose quantitative forecasting methods suite better. Of course current market position compared to closest rivals, signals from biggest customers and so on always require qualitative analyzation.

Demand forecasting (quantitative and qualitative) is naturally an important tool for workforce planning, but there is also other data that could be utilized. Armstrong and Taylor (2014, p. 219) raised a category of internal qualitative data, which is used in workforce planning. There is definitely room for improvement in this category for the case company. Work value ([Revenue - Materials – Subcontracting] / Booked hours) is measured, but it is not yet utilized to its full potential. It could be used especially for mid to longer term resource planning. When measured monthly, it can indicate whether there was under or over capacity on a certain time period. From external data source perspective, weather forecasting data and its effect on volumes (network maintenance tasks especially) would also be an extremely interesting context to investigate.

6.4 Vehicle tracking report development and data utilization

Changes were made to the vehicle tracking reports (visual improvements and improved comparison between vehicles) and a demo was presented to business unit managers. However, the changes are not yet implemented into practice. There are technical and contractual reasons behind this. The important groundwork is done though – the needs were collected and a reference demo of the reports were presented.

As Vivaldini et al. (2012) stated, vehicle tracking is especially beneficial when it is used to optimize driving routes and locating the closest vehicle e.g. in urgent situations on a certain location. In the case company the route optimization is used in task type of deliveries, meaning subscriber installations and fault repair. Now when construction jobs are dispatched to certain dates in the PMIS (and in the future dispatching happens also through the task management system), driving route optimization could be connected to those type of jobs as well. However, driving route optimization in construction jobs is not that crucial, because most of the jobs take around half to one day and even more. Task deliveries are far more fast paced so the routing is more important in that context.

Even though vehicle tracking data can be utilized to track certain individual misbehavior (speeding, a lot of time used on the office etc.), the most important utilization target is to measure the overall performance. Important things to follow monthly: what is average time used on the work area? Average kilometers driven? Average idle time? Average speed? As Aydin et al. (2015) found in their research, with an active monitoring of the key measures (active working vehicles, fuel costs, total kilometers driven), car costs can be dropped and driven kilometers decreased significantly. This is an area where a lot of work is still to be done in the case company, because to information is collected but not really utilized to its full potential. These fieldwork productivity related measures were brought up also in the information model as a one indicator. If the key measures with average actuals are visualized and communicated to the fieldworkers, it would be an efficient way to communicate, what are we doing great on the field and what are the areas we need to improve. It is important to note that consumers and customers always notice the behavior on the traffic and that has a great impact on the company image as well. Thus, the importance of vehicle tracking data analyzation might be a little bigger than the information model would at first reveal.

6.5 Action proposal for the case company

Comprehensive usage of the new project management information system in construction business and in ABC- and D-projects is currently the most important target. This is the basic requirement for the delivery process information utilization: all the construction projects and jobs need to be managed through the system so that the information related to those projects are visible and can be utilized further. During Q2-Q3 of 2017, “Gantt”

module needs to be implemented into to use for ABC-projects. Together with technical development of the project management system, it is then possible to make resource requirements of ABC-projects more transparent. From information models perspective, the business reports e.g. for customer reporting (status reports) and reports related to individual indicators (lead times, booked vs. planned revenue, etc.) need to be developed through the reporting tool. This should be an ongoing activity during Q2 of 2017.

The information model presents all the important indicators that should be monitored, how often and where should the results be reported. However, in the beginning when these models are implemented into use, it is wise to choose core indicators to monitor and lock the schedule, how often should those be reported and analyzed. This discussion should be arranged in late Q2 or in the beginning of Q3. By that time the crucial reports should be ready to use through the reporting tool.

In addition to "Gantt" implementation, for resource planning purposes it is important to integrate the HRM data to the task dispatching system in order to match the resource skills and resource availabilities. As was stated in the results, the proper tool for handling the resource information and managing the dispatching of the construction jobs is the field-work dispatching system (currently used in task business). These integrations and implementations require development projects of their own and they are going to include rather high costs. Taking into consideration the current development projects, it is most likely late Q3-Q4 when these new development projects could be started.

From vehicle tracking system perspective, the next step is to implement the changes made in the reports into production versions. If there are no technical difficulties, the production versions of the new tracking reports could be created relatively quickly. Because the data in the reports is not going to dramatically change, this development action is not prioritized as high as compared to the project management system related development actions. However, during Q3 these changes could be implemented into use. It also needs to be ensured that the new reports are used and utilized as planned.

The proposed actions for the case company are compiled to Figure 16 as a roadmap. The schedule for the actions is directional. The prioritization of the actions are visualized with colors (red = highest priority, yellow = moderate priority, green = lowest priority).

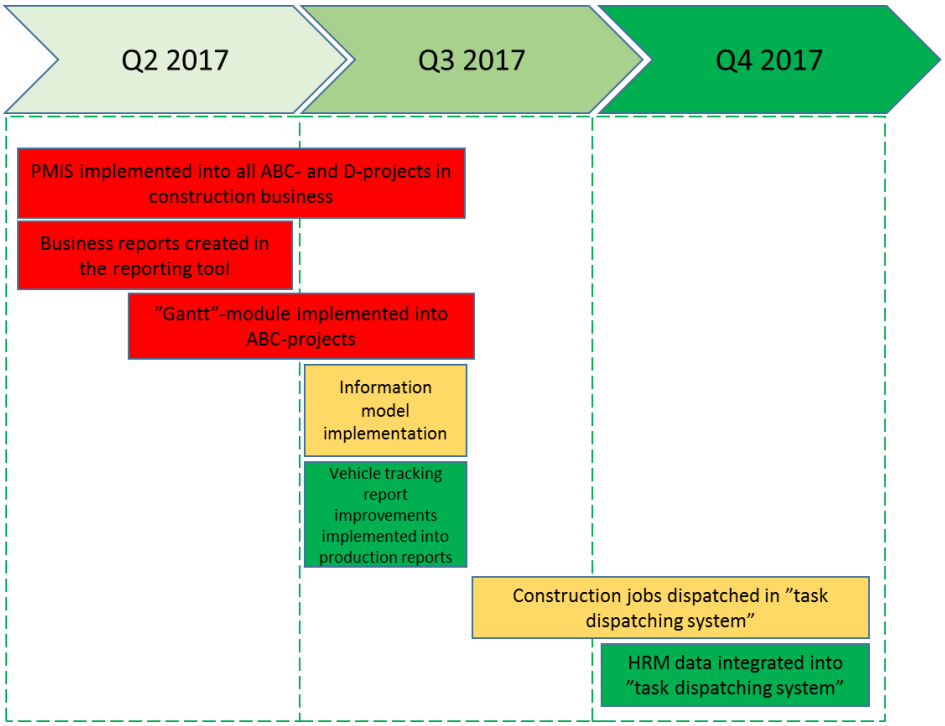

Figure 16. *Roadmap with proposed actions for the case company.*

As the roadmap presents, the priority of dispatching construction jobs in “task dispatching system” is higher compared to the vehicle tracking report improvements implementation into production. However, the dispatching related project is going to require significant amount of resources, which most likely forces the case company to postpone that development action.

7. CONCLUSION

This research concentrated on project type deliveries (ABC- and D-projects) process information and its utilization especially in project and resource management. The interest was in the information that should be gathered from information systems and further utilized in these crucial business areas in order to improve the performance of business units. The main research question was formulated in the following way:

How can business units improve their performance in project/work management and resource management?

The two research sub-questions under this main question were the following:

1. *What delivery process related information do BUs need in BU's project management?*
2. *What relevant information/data should BUs collect from sales and delivery processes for BU's resource management (including human resources and vehicles)?*

The objectives for this research were divided into managerial and scientific categories. Information usage and utilization improvement was the most important objective from management point of view. Crucial project and resource related information need to distinguished and how information systems and IT tools can be used to utilize the important information. From scientific point of view, the objective was to identify the importance of information systems in project business and propose ways how information and information systems can be used to improve business performance.

7.1 Responses to research questions

To answer to the first sub-question, the created information models in this research give relevant viewpoints for this topic. First of all, the gathered crucial information can be divided into categories, which in this case were finance, schedule, quality, productivity, resourcing, work safety and communication. Each of these categories hold certain number of indicators or measures, which should be of interest for business unit managers and even further for planning engineers in the case company. Examples of important indicators are planned vs. actual profit margins in projects, lead times for jobs under certain project and lost workday injury frequency. The information model is a tool to keep track, which indicators should be followed, where can BU managers receive this information and how often it should be reported further.

When the crucial information is followed closely, it is easier to spot the areas where project type delivery is performing well and on the other hand, in which areas there is room

for improvement. The goal is to create action points based on the indicator values to improve those values. When those values are improved, it means that the project type delivery performance is improved as well. When project type delivery performance is systematically improved, the whole business unit performance is higher. So this could be seen as some kind of domino effect: with the help of the crucial indicators, the challenges and difficulties in the projects can be spotted and corrective actions developed, which would eventually show positive effects in business performance. One practical example of this is a project, where planned margins were significantly better compared to actuals. When the reasons behind these numbers were evaluated, it became clear that all the fixed costs (e.g. project management costs) were not included in great detail in the planning phase. When next similar projects are offered and delivered, these past experiences can be utilized to improve the project type delivery performance. On the other hand, when excellent project activities are created and used, these best practices should be utilized also in the upcoming projects.

Answers to the second research sub-question were compiled in the medium-term resource planning construction and improved vehicle tracking report sections. From human resource planning perspective, it is important to utilize e.g. the human resource management system to list the capabilities and skills of the personnel. Sales information is utilized especially in the longer term, when resource demand requirements are estimated for projects that were won in the bidding phase. The most important information source is the project management information system, where the projects and jobs are planned in detail. When this planning is made in Gantt (tool for project scheduling), the resource requirements for each phase of the project can be clarified. When these requirements are combined with the available resources and their skills, the project managers can estimate the need for new workers or the amount of subcontracting needed.

The vehicle tracking report (old form) that was used in the case company already included useful information that should be utilized, but the information that was presented in the report was visually lacking. The important information was difficult to spot and it was also challenging to compare the individual vehicle performance against another vehicle. “Traffic light” functionality was added to the reports, which improves significantly the visual side of the reports and makes it easier to focus on the important information, thus making the analyzation of the current situation faster. Length of the day, time used on the work area and time used for driving are examples of indicators that should be especially interesting for BU managers. If driving times are exceptionally long and time used on the work area is low, there might be problems in the way the working day is compiled for the technician: the distances between working areas are long or the driving routes are not optimal. The point is that this important information has to be gathered and analyzed in order to improve the vehicle performance and maximize the time used on the work area. When the time on the work area is maximized, also the potential for higher invoicing is maximized, thus opening ways to again improve business unit performance.

In summary, business units can improve their performance by utilizing information systems to restore and analyze (together with reporting analyzation tools) project and resource related information regarding project type delivery process. When information systems are utilized properly and relevant project data is fed to the system in real time, project managers can use that information to make better business decisions. These results highlight the importance of information systems as a supportive tool in business monitoring and decision making, which is one of the central contributions that this research has to the research community. An important observation made in this research was also the fact that the information system's information quality is just as good as the information that is fed to the system. If the system usage is lacking or the information is not relevant (meaning it is old or incorrect), information quality is not good enough for decision making. Information system implementation alone is not the solution or medicine for better business decision making and business performance development, but the important part is that the IT systems need to be implemented correctly through carefully planned process steps, where change management is one crucial area.

Based on the findings made in this research, it can be concluded that the objectives for this research were achieved. The created information models, resource planning process description and vehicle tracking needs gathering and report development were sufficient constructions and results to satisfy the managerial aspect: important project performance and resource management related indicators were identified. The information system importance in storing the necessary data, analyzing it into information and distribution it to shareholders was underlined. Scientific objectives were satisfied with framework on the use of delivery process information in improving business performance. In addition, the discussion on PMIS and reporting tool effect on project performance analyzation and improvement, as well as PMIS, HRM system and vehicle tracking system utilization in resource management supported the achievement of these objectives.

7.2 Research contributions

This research proposes that the use of information models, where performance indicators, information sources, reporting frequencies and targets are listed, can be an efficient tool to be used for project management and business performance improvement purposes. This is a fresh approaching method in the project business research environment, because traditionally the key performance indicators are identified in the research context, but there is less discussion on utilizing IT tools and systems to manage and analyze those indicators.

The results of this research strengthens the importance of performance indicators related to financial, schedule and quality measures. These are key categories for business performance measurement and create the basis for the evaluation on how well the business is performing in projects. Other results in line with the earlier research were the information

quality related findings. If the system usage is lacking and the information is not put to the system on daily basis, the quality of the information might not be good enough for important business decision making. The lack of system usage might be caused by e.g. a dissatisfaction on system functionalities or resistance to change working methods.

The framework on the use of delivery process information to improve business performance was the key result of this research. It presented, what delivery process related information should be gathered and analyzed, which information systems should be utilized and how the information should be presented in order to improve project type delivery and resource management performance. This framework would be a suitable starting point for further research, where e.g. information model implementations are discussed or PMIS cost and time efficiency values are evaluated.

7.3 Future research topics

The project management system functionalities and benefits were discussed in detail in this research, but in the future it would be an interesting research topic to investigate and evaluate the possible time and cost savings for service business company of the project management system usage for example in a case of a single ABC-project. The implementation of a project management system and its benefits needs to be expressed in financial figures; otherwise it is extremely difficult to justify its use for upper management.

From the case company perspective, there are several future development topics that could be relevant from research perspective as well. For example, capabilities and competencies of the personnel are kept and maintained in the human resource information system, but what is the correct process to keep these competencies up-to-date? The challenge is that the movement of the personnel is constant and safety cards or first aid requirements are fulfilled frequently, making manual capabilities updating very time consuming. The correct and “light” process for this should be investigated in the future.

Another important research topic for the future is the dispatching of fieldwork jobs to the technicians and planning engineers. In the case company, work orders are dispatched from two different system depending on whether the job is related to network construction or network maintenance/fault repair. In the future, it would be beneficial to use only one system to dispatch all jobs and tasks, because then it would be easier to expand the capabilities of the technician to cover both construction and maintenance jobs. At the moment, if technician is able to do both construction and maintenance jobs, he or she has to follow two different work order systems, making it more difficult to handle the work orders and prioritize them as well. The benefits can already partially be seen, but also possible challenges and disadvantages of a single dispatching system need to be evaluated.

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APPENDIX A: INFORMATION MODEL FOR BU MANAGERS

Indicator category	Project	Measure / indicator	Connection to the division level KPI	Could lead to actions during the project	Source	Reporting target	Weekly reporting	Monthly reporting
Finance	ABC- and D-projects	Actual vs. Budgeted revenue & cost during the period (mo)	Revenue EBITDA		*Classified*	FIN TND weekly meeting		x
Finance	ABC- and D-projects	Actual vs. Budgeted profit margin (mo)	Project margin		*Classified*	FIN TND weekly meeting		x
Finance	ABC- and D-projects	Work in Progress	Invoicing	x	*Classified*			
Finance	ABC- and D-projects	Order book value	Project margin		*Classified*	FIN TND weekly meeting	x	
Finance	D-projects	Scheduled payments for jobs with order value over 10 000€	Invoicing	x	*Classified*	BU monthly meeting		x
Finance	ABC- and D-projects	Actual vs. Forecasted invoicing for the period (ongoing month)	Invoicing / Cash flow forecasting		*Classified*	FIN TND weekly meeting	x	
Finance	ABC- and D-projects	Forecasted budgeted revenue and cost for the period (ongoing month)	Delivery accuracy Project margin Resource utilization rate		*Classified*	FIN TND weekly meeting	x	

Indicator category	Project	Measure / indicator	Connection to the division level KPI	Could lead to actions during the project	Source	Reporting target	Weekly reporting	Monthly reporting
Schedule	ABC- and D-projects	Job milestones actual vs. planned schedule	Delivery accuracy		*Classified*	BU monthly meeting		x
Quality	ABC- and D-projects	Job lead time	Delivery accuracy NPS		*Classified*	BU monthly meeting		x
Quality	ABC- and D-projects	Delivery reliability	Delivery accuracy NPS		*Classified*	FIN TND weekly meeting		x
Quality	ABC- and D-projects	Reclamations	NPS		*Classified*			
Quality	ABC- and D-projects	PMIS compliance	Compliance	x	*Classified*	BU weekly meeting with Planning technicians	x	
Quality	ABC- and D-projects	Bottle necks: Job amount per status/milestone	Delivery accuracy Resource utilization rate	x	*Classified*	FIN TND weekly meeting	x	
Quality	ABC-projects	Change management in projects, e.g. cost and schedule changes	Delivery accuracy	x	*Classified*			
Productivity	ABC- and D-projects	Delivered jobs during the period (mo)	Work value		*Classified*	BU weekly meeting with Planning technicians		x

Indicator category	Project	Measure / indicator	Connection to the division level KPI	Could lead to actions during the project	Source	Reporting target	Weekly reporting	Monthly reporting
Productivity	ABC- and D-projects	Delivered jobs and their booked revenue during the period (mo) per job responsible	Work value		*Classified*	Planning technician personally		
Productivity	ABC- and D-projects	Fieldwork productivity indicators, e.g. time used on the work area vs. lenght of the work day	Work value	x	*Classified*	FIN TND weekly meeting		x
Resourcing	ABC- and D-projects	Short time period: Resource requirements for planned jobs	Resource utilization rate	x	*Classified*	BU weekly meeting with Planning technicians	x	
Resourcing	ABC- and D-projects	Medium term resource need evaluation based on technical planning of jobs	Resource utilization rate		*Classified*	BU weekly meeting with Planning technicians	x	
Resourcing	ABC- and D-projects	Long term resource need evaluation by work type	Resource utilization rate		*Classified*	BU monthly meeting		x
Resourcing	ABC- and D-projects	Work value: portfolio and work type based value Formula: (Revenue - Materials - Subcontracting) / Booked hours	Work value		*Classified*	FIN TND weekly meeting		x
Resourcing	ABC- and D-projects	Capacity utilization rate: Formula: Booked hours for jobs / Work hours in total	Work value Resource utilization rate	x	*Classified*	FIN TND weekly meeting		x
Resourcing	D-projects	New confirmed jobs in PMIS by week	Cash flow forecasting Resource utilization rate		*Classified*			

Indicator category	Project	Measure / indicator	Connection to the division level KPI	Could lead to actions during the project	Source	Reporting target	Weekly reporting	Monthly reporting
Work safety	ABC- and D-projects	Occupational accident / Safety notes	LWIF	x	*Classified*	FIN TND weekly meeting BU monthly meeting	x	x
Work safety	ABC- and D-projects	LWIF (Lost Workday Injury Frequency)	LWIF		*Classified*	BU monthly meeting		x
Communication	ABC- and D-projects	Customer feedback	NPS	x	*Classified*	BU monthly meeting		x
Communication	ABC- and D-projects	Feedback from White-collar workers / Field workers	Internal communication Voice / Pulse results	x	*Classified*	FIN TND weekly meeting		x
Communication	ABC- and D-projects	Communication from upper management: Business goals etc.	Internal communication	x	*Classified*	BU weekly meeting with Planning engineers BU monthly meeting	x	
Communication	ABC-projects	Risk management: detected risks and corrective actions	Delivery accuracy	x	*Classified*			

APPENDIX B: INFORMATION MODEL FOR PLANNING ENGINEERS

Indicator category	Project	Measure / indicator	Connection to the division level KPI	Could lead to actions during the project	Source	Reporting target	Weekly reporting	Monthly reporting
Finance	ABC- and D-projects	Actual vs. Budgeted revenue & cost during the period (mo)	Project margin	x	*Classified*	BU weekly meeting with Planning engineers		x
Finance	ABC- and D-projects	Actual vs. Budgeted profit margin (mo)	Project margin		*Classified*	BU weekly meeting with Planning engineers		x
Finance	D-projects	Scheduled payments for jobs with order value over 10 000€	Invoicing	x	*Classified*	BU monthly meeting		x
Finance	ABC- and D-projects	Actual invoicing for the period (ongoing month)	Invoicing		*Classified*	BU weekly meeting with Planning engineers		x
Finance	ABC- and D-projects	Planned jobs and revenue 3 weeks forward	Delivery accuracy Project margin Resource utilization rate		*Classified*	BU weekly meeting with Planning engineers	x	
Schedule	ABC- and D-projects	Job milestones actual vs. planned schedule	Delivery accuracy	x	*Classified*	BU weekly meeting with Planning engineers		x
Schedule	ABC- and D-projects	Job status	Delivery accuracy	x	*Classified*	Customer		
Quality	ABC- and D-projects	Job's change management (products, schedule)	Delivery accuracy	x	*Classified*	Customer		
Quality	ABC- and D-projects	Reclamations	Delivery accuracy NPS	x	*Classified*	BU manager		

Indicator category	Project	Measure / indicator	Connection to the division level KPI	Could lead to actions during the project	Source	Reporting target	Weekly reporting	Monthly reporting
Quality	ABC- and D-projects	Bottle necks: Job amount per status/milestone	Delivery accuracy Resource utilization rate	x	*Classified*	BU weekly meeting with Planning engineers	x	
Productivity	ABC- and D-projects	Delivered jobs and their booked revenue during the period (mo)	Work value		*Classified*	BU manageri		x
Communication	ABC- and D-projects	Customer feedback	NPS	x	*Classified*	BU weekly meeting with Planning engineers	x	
Communication	ABC- and D-projects	Technician feedback	Internal communication Voice / Pulse results	x	*Classified*	BU weekly meeting with Planning engineers	x	
Communication	ABC- and D-projects	Problems/challenges, development ideas (product group)	Internal communication		*Classified*	Product group meeting		x
Communication	ABC- and D-projects	Feedback from product group meetings	Internal communication		*Classified*	BU weekly meeting with Planning engineers		x
Communication	ABC-projects	Risk management: detected risks and corrective actions	Delivery accuracy Internal communication	x	*Classified*	BU weekly meeting with Planning engineers	x	